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**Ishihara**

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(54) **HEAD REST**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,350,859 B2 \* 4/2008 Klukowski ..... B60N 2/4885  
297/216.12  
7,520,564 B2 \* 4/2009 Woerner ..... B60N 2/4864  
297/216.12  
7,717,507 B2 \* 5/2010 Toda ..... B60N 2/4885  
297/216.12

(Continued)

FOREIGN PATENT DOCUMENTS

CN 2350244 Y 11/1999  
CN 101309618 A 11/2008

(Continued)

OTHER PUBLICATIONS

Jan. 8, 2013 International Search Report issued in International  
Application No. PCT/JP2012/074730.

(Continued)

*Primary Examiner* — Philip Gabler

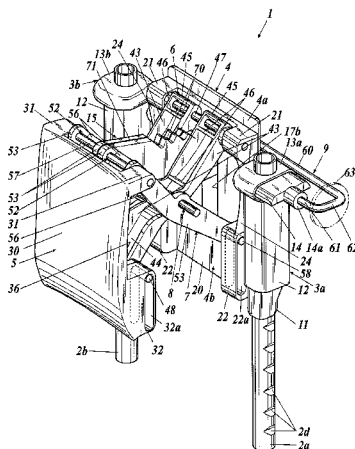
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**ABSTRACT**

A headrest includes linkage supports with high rigidity. The headrest includes a first headrest pillar and a second headrest pillar, a stationary unit disposed between the first and the second headrest pillars, a movable unit which is movable forward away from the stationary unit and backward toward the stationary unit, and a linkage linking the stationary unit with the movable unit. The linkage includes linkage segments. The stationary unit and the movable unit include supports, respectively. The linkage segments are rotatably connected to and supported by the respective supports. The supports each have a width in the widthwise direction and a thickness in the front-rear direction, the width is greater than the thickness.

**10 Claims, 14 Drawing Sheets**



(52)	<b>U.S. Cl.</b> CPC ..... <b>B60N 2/4864</b> (2013.01); <i>B60N 2002/4894</i> (2013.01)	JP	2008001171 A	1/2008
		JP	4280589 B2	6/2009
		JP	2010149695 A	7/2010
		JP	2010247736 A	11/2010

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,770,967 B2 *	8/2010	Hirota .....	B60N 2/002 297/216.12
7,963,598 B2 *	6/2011	Akaike .....	B60N 2/002 297/216.12
2004/0262974 A1 *	12/2004	Terada .....	B60N 2/4864 297/407
2005/0280304 A1	12/2005	Akaike et al.	

FOREIGN PATENT DOCUMENTS

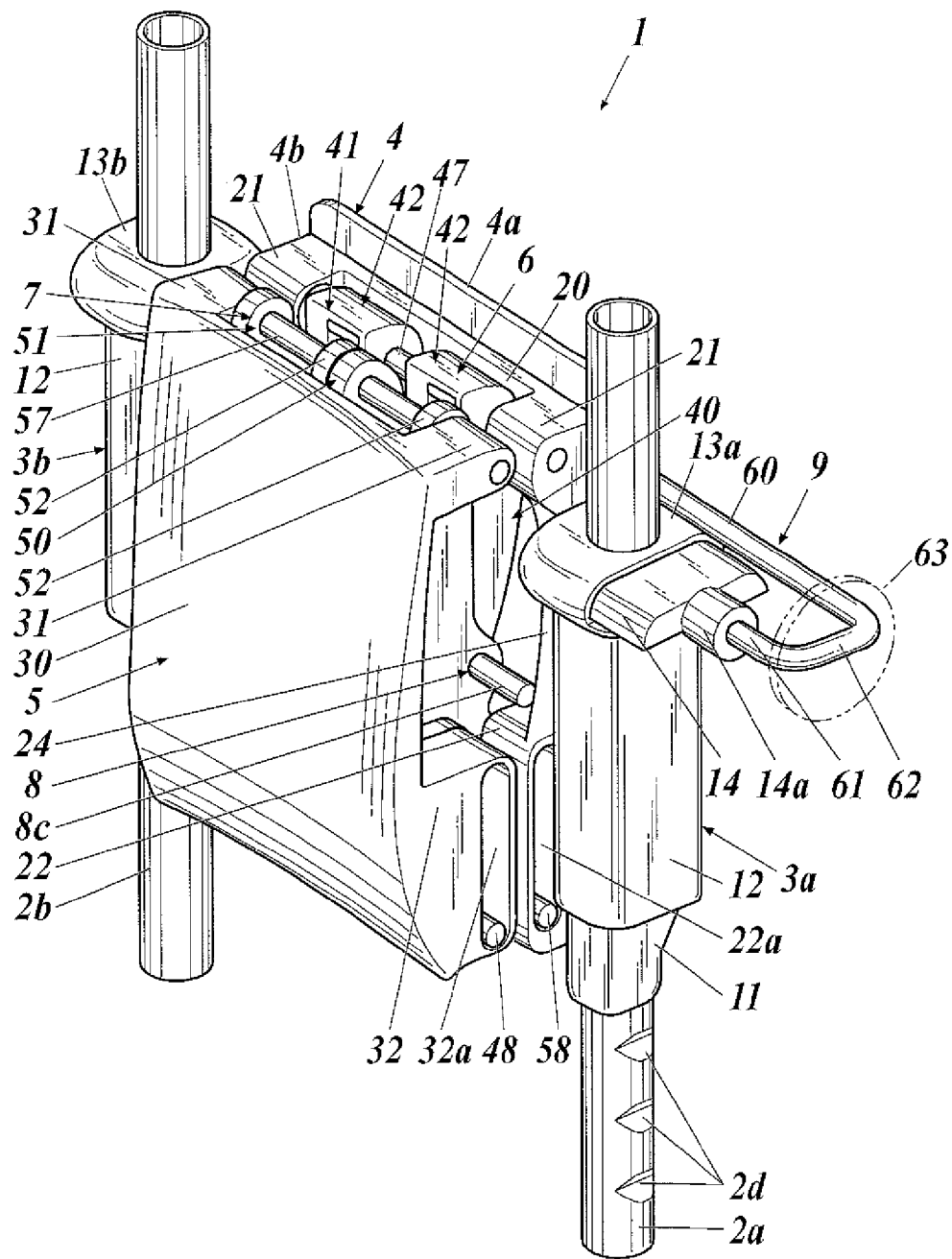
EP	288 062 A1	3/2003
JP	2006027593 A	2/2006

OTHER PUBLICATIONS

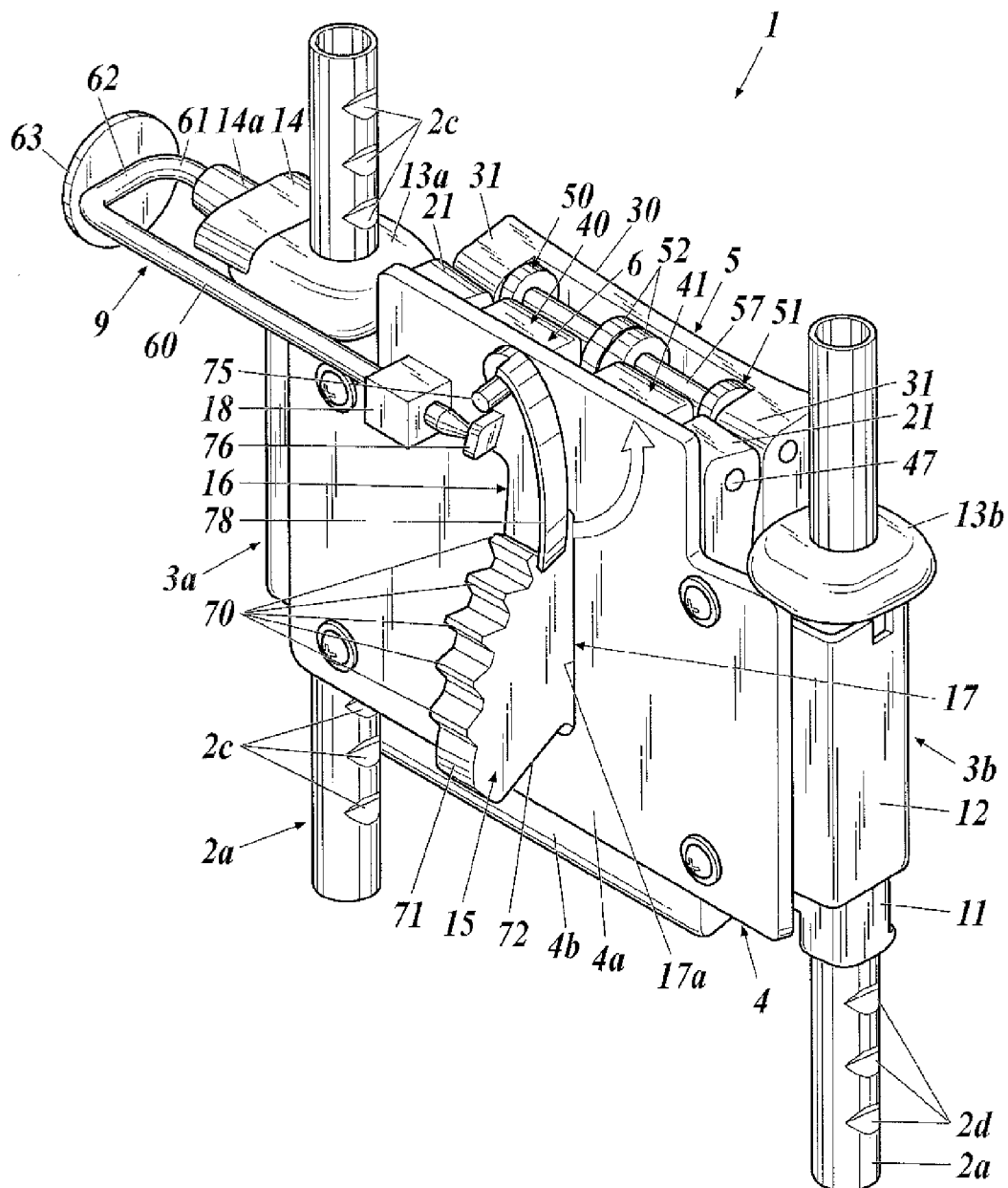
Mar. 31, 2015 International Preliminary Report on Patentability issued in International Patent Application No. PCT/JP2012/074730.  
May 17, 2016 Office Action issued in Japanese Patent Application No. 2014-537908.  
May 3, 2016 Search Report issued in European Patent Application No. 12885632.5.  
May 9, 2016 Office Action issued in Chinese Patent Application No. 201280076066.8.

\* cited by examiner

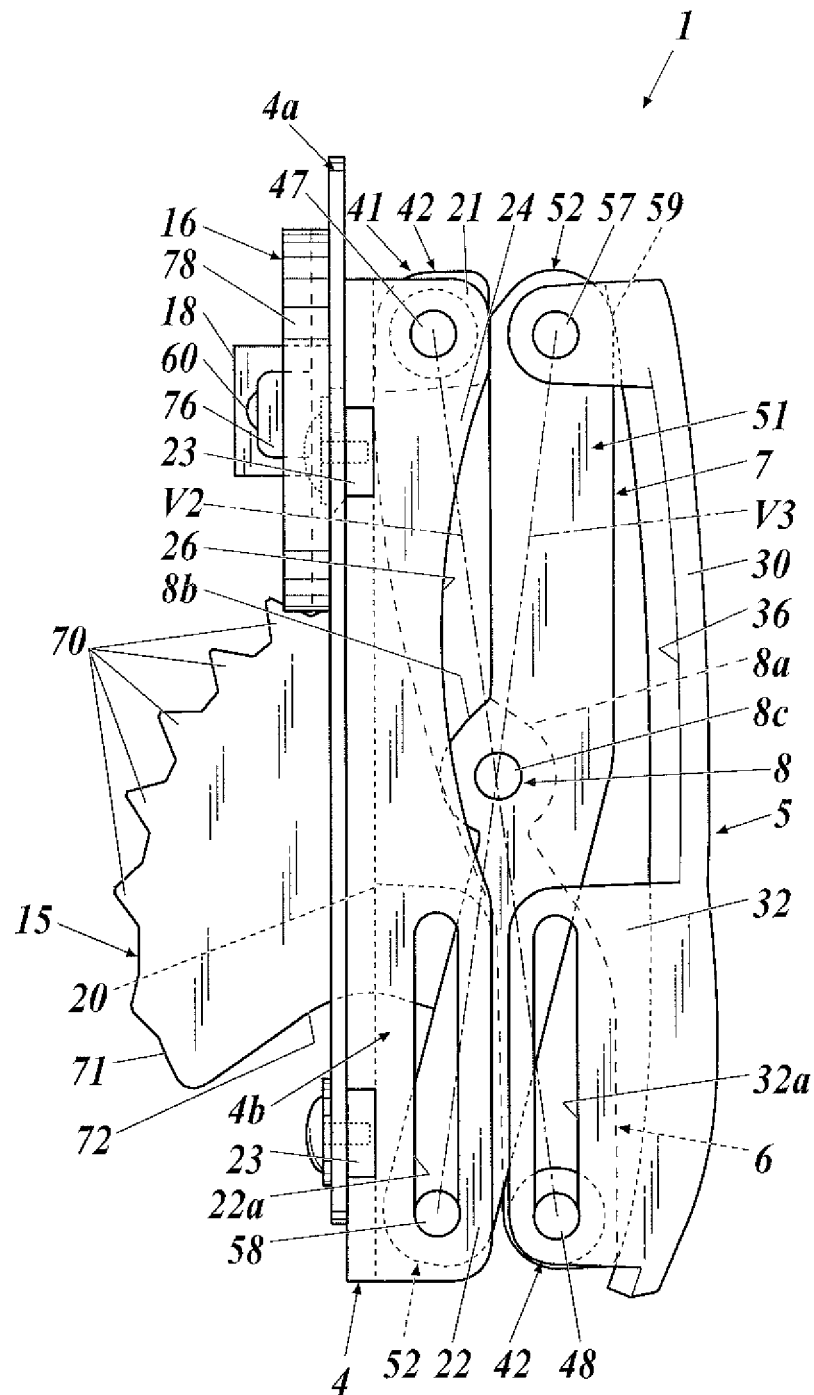
**FIG. 1**



**FIG. 2**



**FIG. 3**





**FIG. 5**

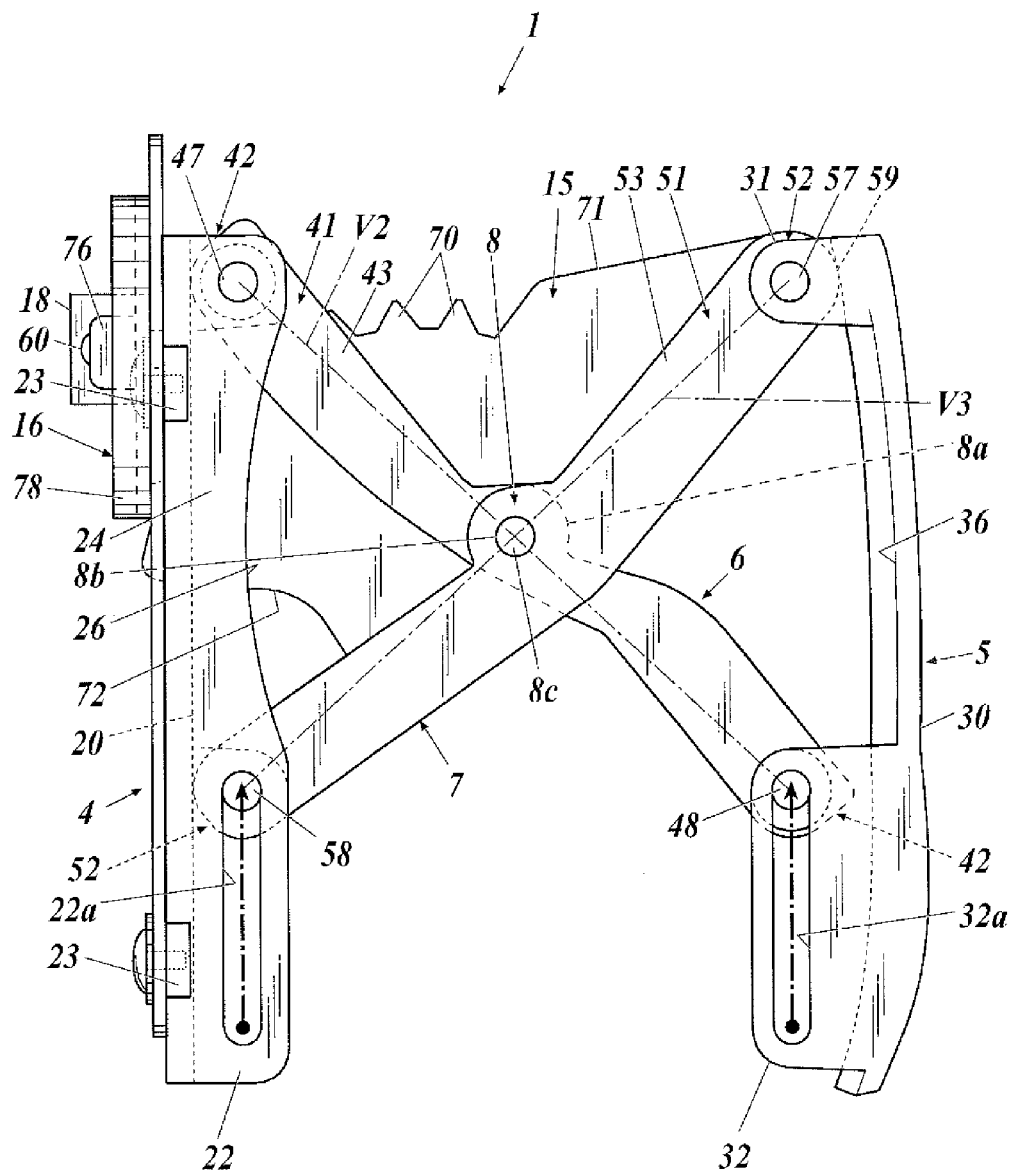
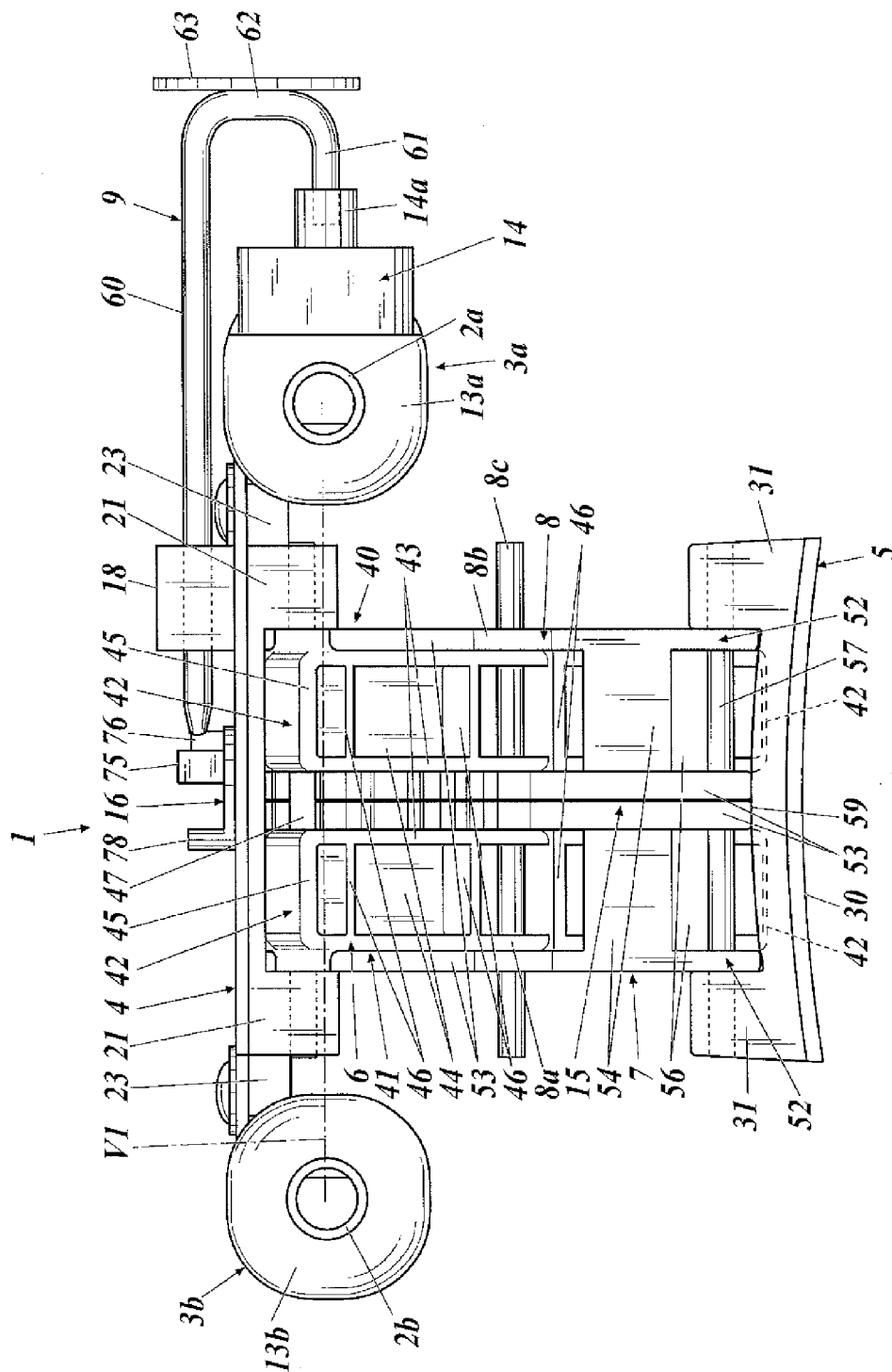
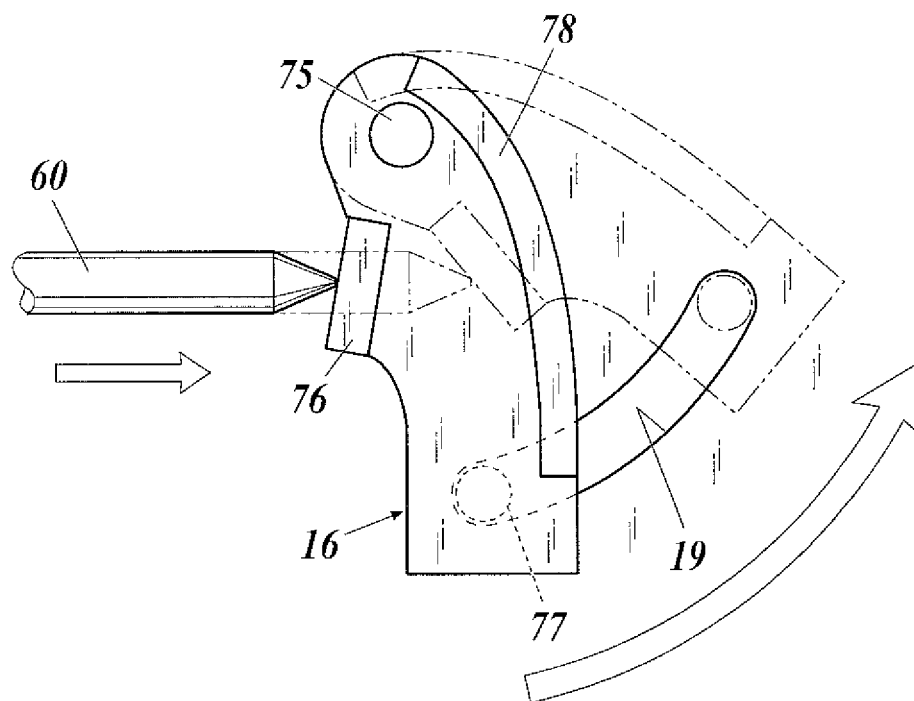


FIG. 6

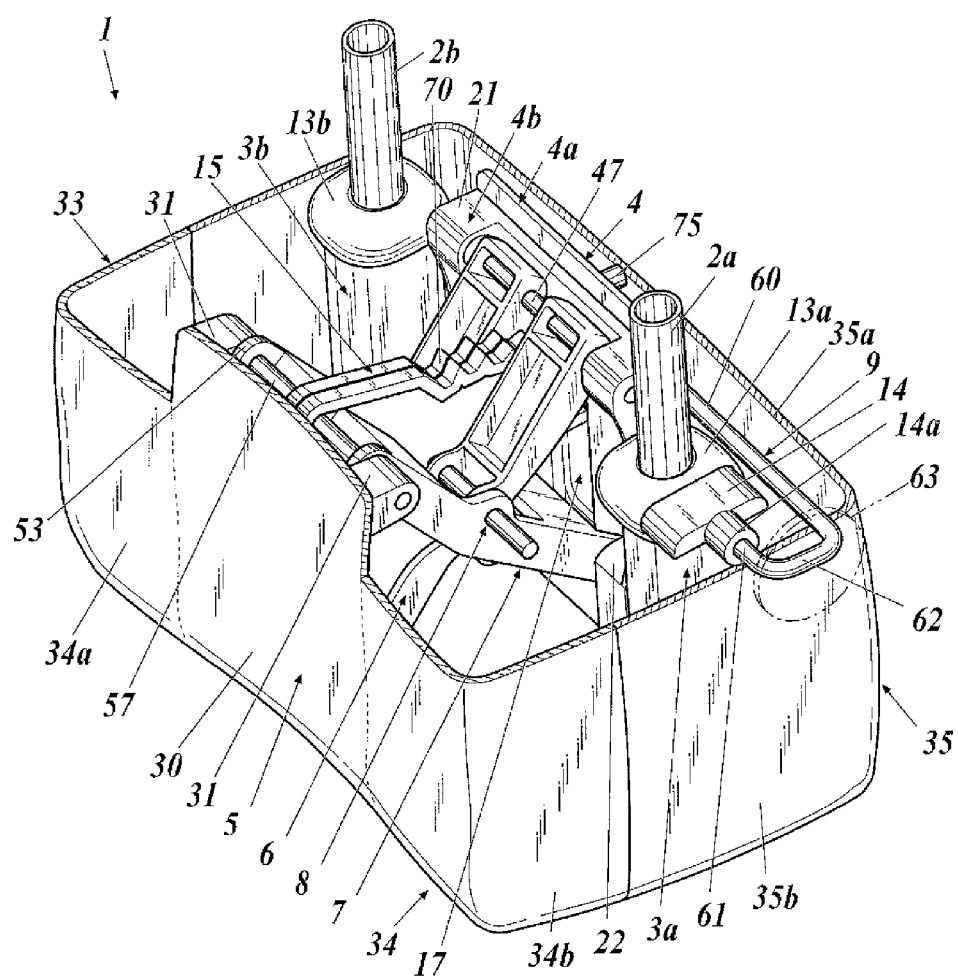




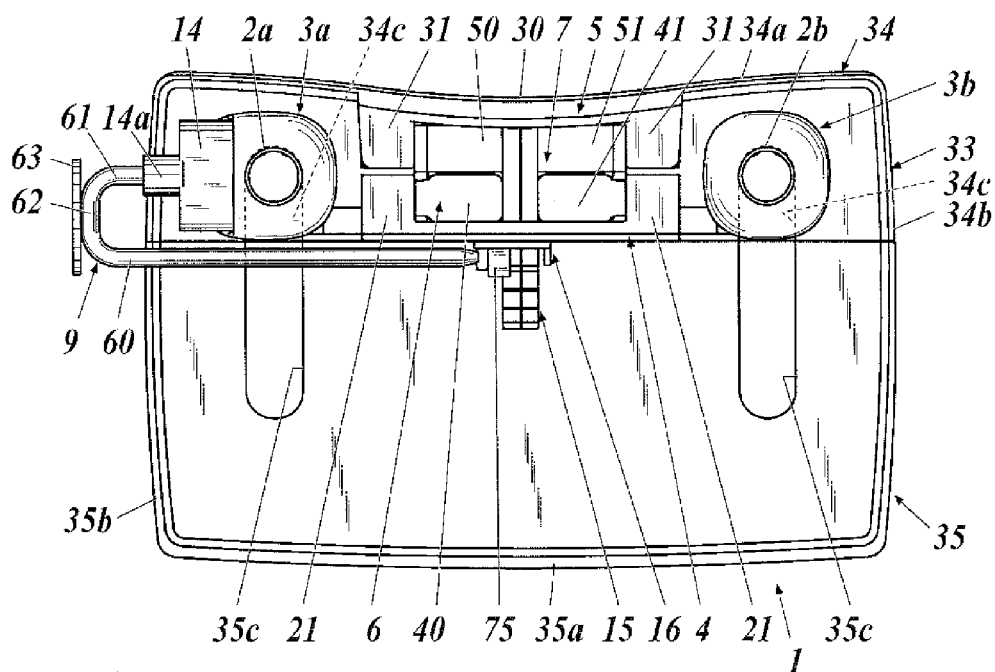
**FIG. 7**



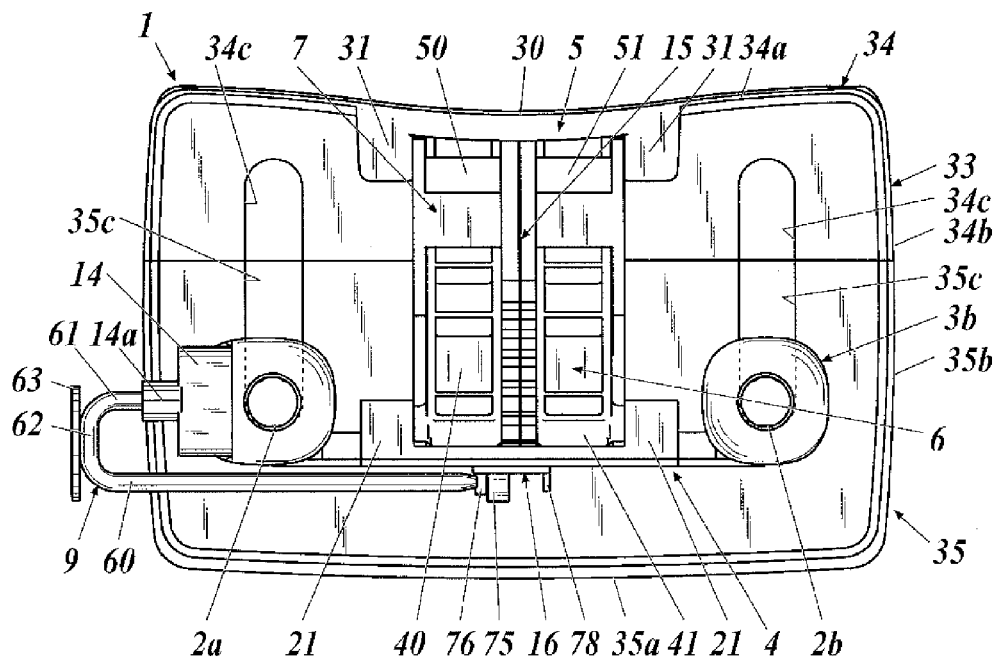
**FIG. 8**



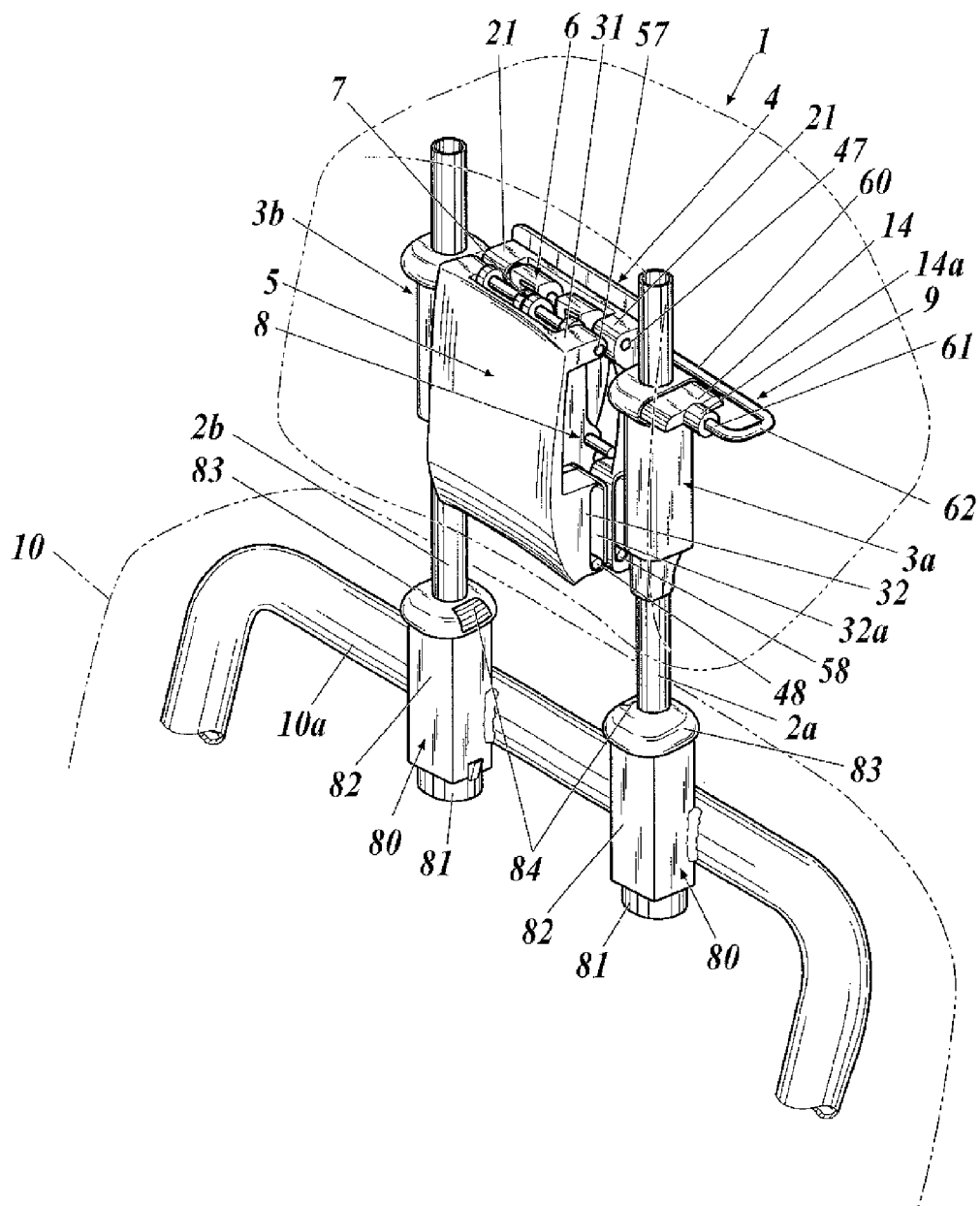
**FIG. 9**



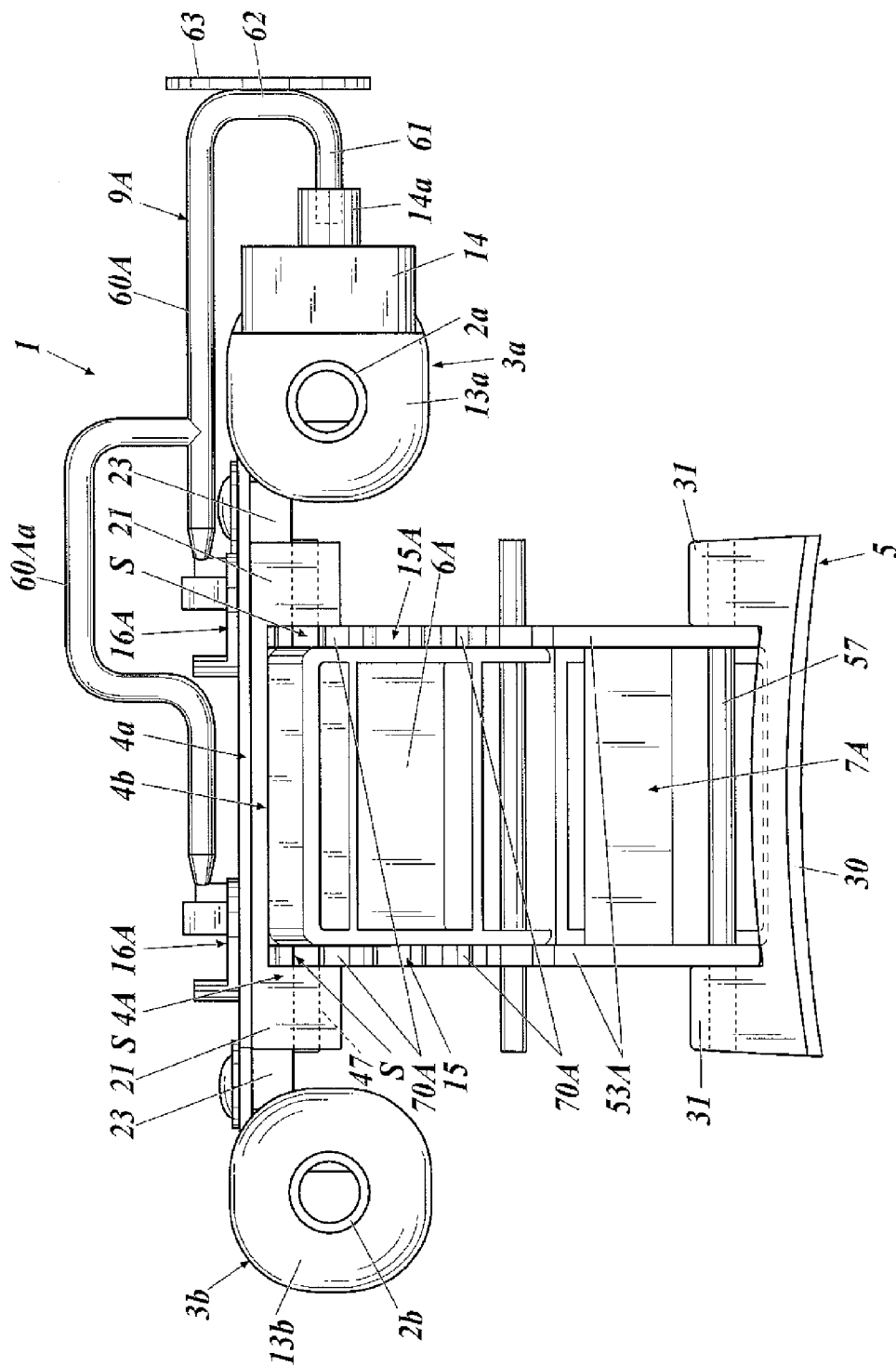
**FIG. 10**



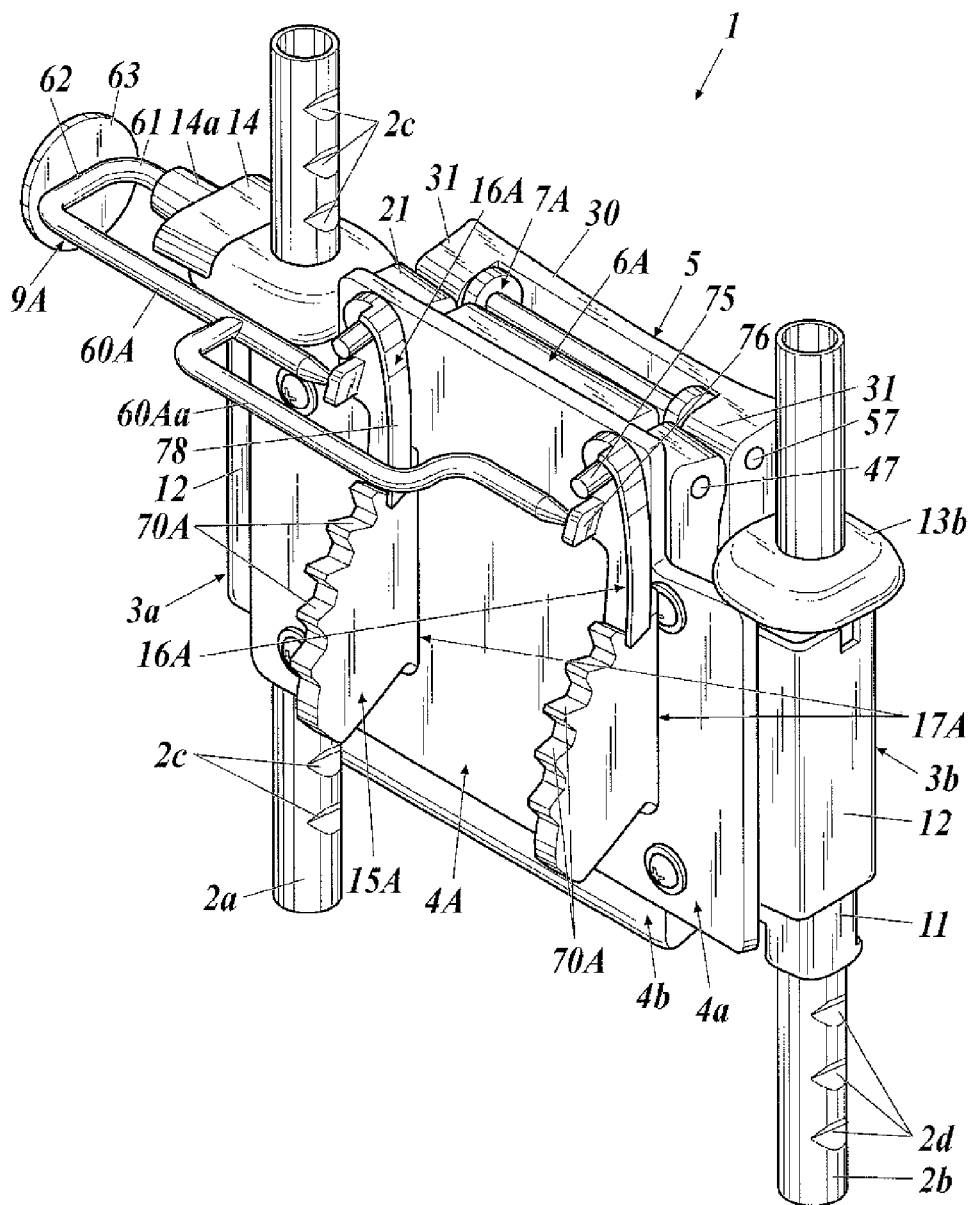
**FIG. 11**



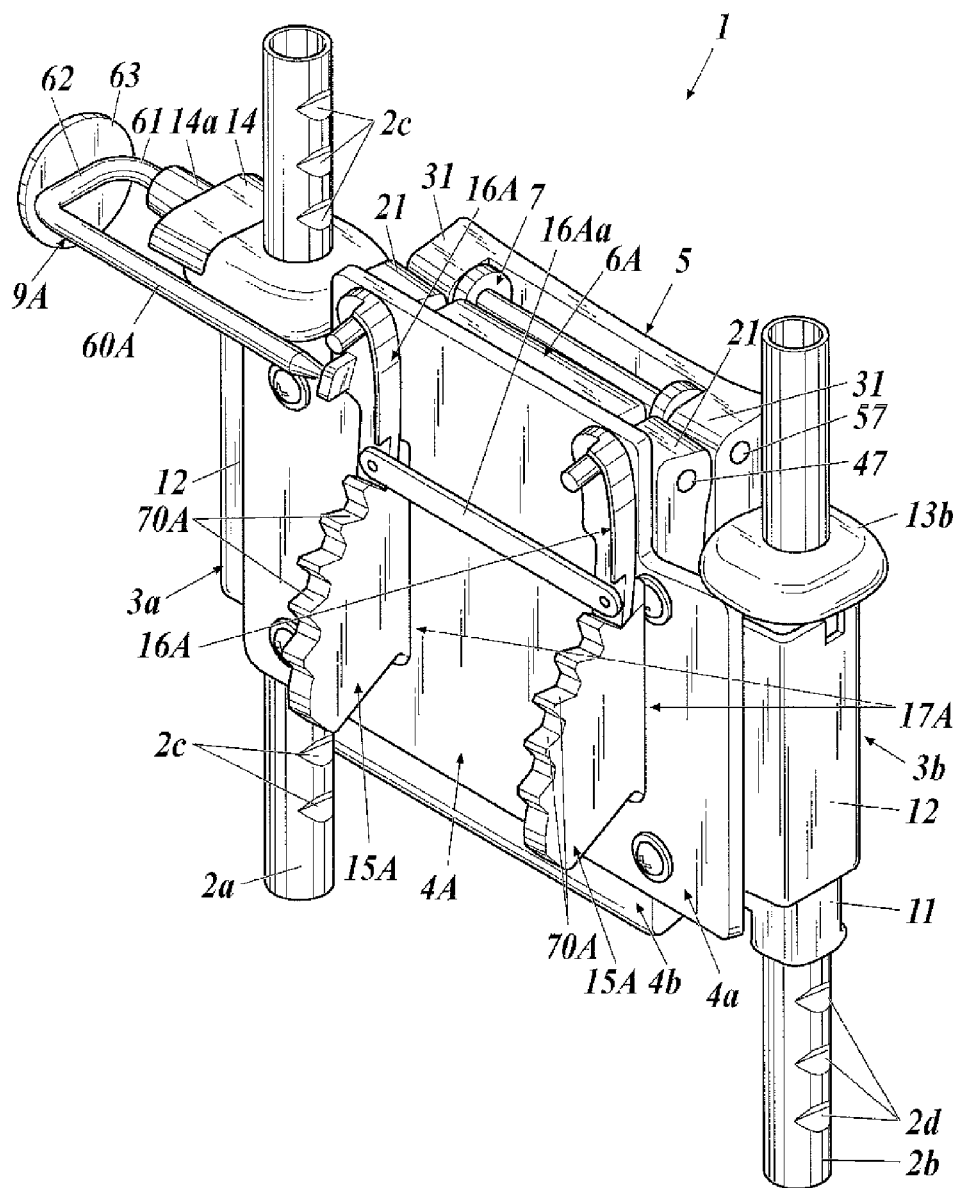
**FIG. 12**



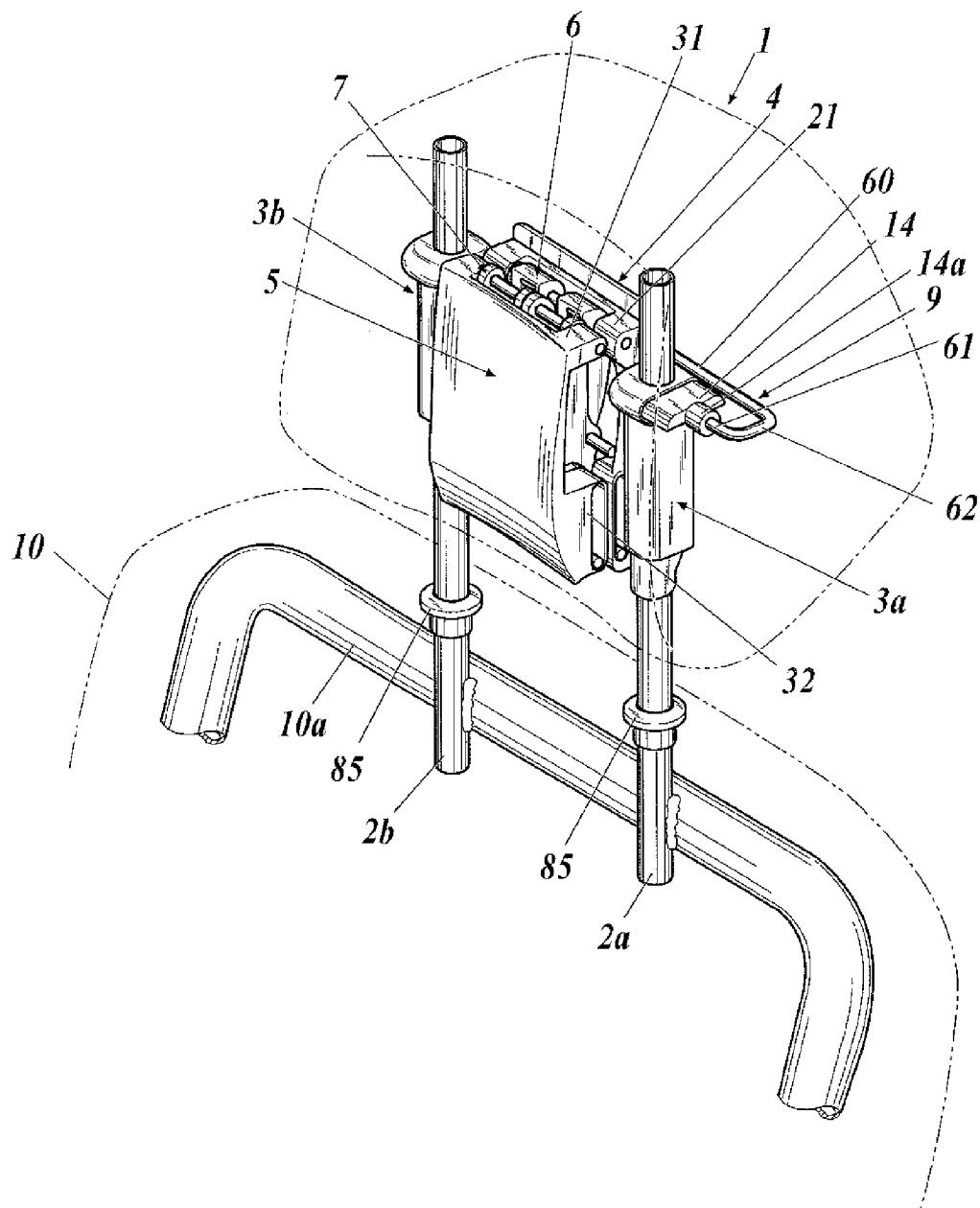
**FIG.13**



**FIG. 14**



**FIG. 15**





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**HEAD REST****TECHNICAL FIELD**

The present invention relates to a headrest to be mounted to a vehicle seat.

**BACKGROUND ART**

Headrests of vehicle seats improve the seating comfort and the safety through the support of heads of occupants upon a vehicle collision.

Patent Literature 1 discloses a headrest including a rear section fixed to headrest pillars, and a front section that is connected to the rear section with a pair of X linkage segments of a linkage and moves apart from the rear section upon a rear-end collision. The movement of the front section of the headrest apart from the rear section is caused by an unlocking operation of a solenoid in response to the rear-end collision.

Such a headrest, which includes the X linkage segments functioning as diagonal supports, has sufficient strength against the stress of a head pushing back the front section of the headrest.

**CITATION LIST****Patent Literature**

Patent Literature 1: Japanese Patent No. 4280589

**SUMMARY OF INVENTION****Technical Problem**

The headrest disclosed in Patent Literature 1 includes a front component which can move only at the time of a rear-end collision. The position of the front component of the headrest cannot be adjusted in the front-rear direction under normal conditions. Thus, it has been desired to develop a headrest having a stepwise adjustment mechanism on the position of the front component in the front-rear direction under normal conditions.

Under normal conditions, headrests undergo internal stress applied not only in the direction of pressing back the front component but also in various directions. In particular, linkage supports provided on front and rear brackets (hereinafter referred to as movable and stationary units, respectively) to support linkage segments via rotary shafts suffer internal stress applied in various directions.

It is an object of the present invention to provide a headrest including linkage supports with improved high rigidity.

**Solution to Problem**

To solve the problem, a headrest according to claim 1 includes, a first headrest pillar and a second headrest pillar; a stationary unit disposed between the first and the second headrest pillars; a movable unit movable forward away from the stationary unit and backward toward the stationary unit; and a linkage linking the stationary unit with the movable unit, wherein the stationary unit and the movable unit each include a plurality of supports rotatably connected to respective linkage segments constituting the linkage, the supports support the linkage segments, and the supports each have a first size in a widthwise direction of the headrest and a

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second size in an front-rear direction of the headrest, the first size being greater than the second size.

The invention of claim 2 is the headrest according to claim 1, wherein the supports of the stationary unit are disposed on both lateral sides of the stationary unit and the supports of the movable unit are disposed on both lateral sides of the movable unit, and the linkage segments of the linkage are disposed between the supports on both lateral sides of the stationary unit and between the supports on both lateral sides of the movable unit.

The invention of claim 3 is the headrest according to claim 1 or 2, wherein the linkage is an X linkage comprising an inside linkage segment and an outside linkage segment rotatably connected to each other via a connecting intersection located in the center of the x linkage, wherein the supports of the stationary unit are disposed on both upper and lower sides of the stationary unit and the supports of the movable unit are disposed on both upper and lower sides of the movable unit, the lower support among the supports on the stationary unit and the lower support among the supports on the movable unit are longer than the respective upper supports in length in a vertical direction of the headrest, and a lower end of the inside linkage segment and a lower end of the outside linkage segment are movable along the respective lower supports in the vertical direction.

The invention of claim 4 is the headrest according to claim 3, wherein the stationary unit further includes a plate-like base fixed to the first and the second headrest pillars; and a body attached to a front face of the base, the body being connected to the linkage, wherein the body includes a plurality of fixing portions integrated with the body on at least four corners of the body and fixed to the base, and the upper fixing portions among the fixing portions are disposed at a height substantially equal to a height of the upper support on the stationary unit.

The invention of claim 5 is the headrest according to claim 3, wherein the stationary unit further includes a plate-like base fixed to the first and the second headrest pillars; and a body attached to a front face of the base, the body being connected to the linkage, wherein the body includes a plurality of fixing portions integrated with the body on at least four corners of the body and fixed to the base, and the upper fixing portions among the fixing portions are disposed at a height different from a height of the upper support on the stationary unit.

The invention of claim 6 is the headrest according to claim 5, wherein the stationary unit further includes an integrated reinforcing rib between the upper and the lower supports, and the upper fixing portions among the fixing portions are disposed at a height substantially equal to a height of the reinforcing rib.

The invention of claim 7 is the headrest according to any one of claims 4 to 6, wherein the lower fixing portions among the fixing portions are disposed at a height substantially equal to a height of the lower support on the stationary unit.

The invention of claim 8 is the headrest according to any one of claims 1 to 7, wherein the supports on the stationary unit are disposed behind a virtual line joining axes of the first and the second headrest pillars.

**Advantageous Effects of Invention**

According to the invention of claim 1, the linkage segments that constitute the linkage are rotatably connected to and supported by the respective supports, and the supports each have a longer length in the widthwise direction than a

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length in the front-rear (thickness) direction. This configuration provides high rigidity in the supports. The supports thereby are barely affected by the impact of internal stress applied in various directions. As a result, the supports can stably support the respective linkage segments.

According to the invention of claim 2, the portions of the linkage segments that are supported by the supports of the stationary unit overlap with the supports in the right-left direction. The portions of the linkage segments that are supported by the supports of the movable unit overlap with the supports in the right-left direction. Thus, the linkage segments can collapse so that the stationary unit and the movable unit are in immediate proximity to each other when the movable unit is brought back. As a result, the headrest can get more compact.

According to the invention of claim 3, the lower support of the stationary unit and the lower support of the movable unit are longer than the respective upper supports in the vertical direction of the headrest. Thus, the lower supports have greater rigidity than the upper supports. The lower end of the inside linkage segment and the lower end of the outside linkage segment can move along the respective lower supports in the vertical direction. Thus, the movable unit can move forward away from the stationary unit and backward toward the stationary unit with the heights of the upper ends of the inside and the outside linkage segments kept unchanged such that the lower ends of the inside and the outside linkage segments move along the respective lower supports. The movable unit can thereby move forward away from the stationary unit and backward toward the stationary unit without any change in height with respect to the stationary unit.

In other words, this configuration enables the movable unit to move without any change in height with respect to the stationary unit through the lower supports and provides high rigidity in the lower supports.

According to the invention of claim 4, the upper fixing portions among the fixing portions are disposed at a height substantially equal to the height of the upper support of the stationary unit. Thus, the upper fixing portions reinforce the upper support and vice versa. This configuration provides high rigidity both in portions at which the body is fixed to the base and in a portion at which the upper support is connected to the inside linkage segment or the outside linkage segment.

According to the invention of claim 5, the upper fixing portions among the fixing portions are disposed at a height different from the height of the upper support of the stationary unit. Thus, connection of the upper support to the inside linkage segment or the outside linkage segment and fixing of the upper fixing portions to the base can be performed at different heights. This configuration facilitates the assembly of each member of the stationary unit.

According to the invention of claim 6, a reinforcing rib is disposed between and is integrated with the upper and the lower supports in the stationary unit. Thus, the stationary unit achieves high rigidity. The upper fixing portions among the fixing portions are disposed at a height substantially equal to the height of the reinforcing rib. This configuration provides high rigidity in portions at which the body is fixed to the base even if the upper fixing portions are disposed at a height different from the height of the upper support.

According to the invention of claim 7, the lower fixing portions among the fixing portions are disposed at a height substantially equal to the height of the lower support of the stationary unit. Thus, the lower fixing portions reinforce the lower support and vice versa. This configuration provides

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high rigidity both in portions at which the body is fixed to the base and in a portion at which the lower support is connected to the inside linkage segment or the outside linkage segment.

According to the invention of claim 8, the supports of the stationary unit are disposed behind the virtual line joining the axes of the first and the second headrest pillars. Thus, the stationary unit is accommodated in a space between the first and the second headrest pillars. The inside and the outside linkage segments of the linkage can also be accommodated as much as possible in the space between the first and the second headrest pillars when the movable unit is brought back. As a result, the headrest can get more compact.

#### BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a front perspective view of a headrest before movement;

FIG. 2 is a rear perspective view of a headrest before movement;

FIG. 3 is a side view of a headrest before movement;

FIG. 4 is a front perspective view of a headrest after movement;

FIG. 5 is a side view of a headrest after movement;

FIG. 6 is a plan view of a headrest after movement;

FIG. 7 is an enlarged view illustrating the operation of a lock of a front-rear locking mechanism;

FIG. 8 is an exploded front perspective view of a headrest including a headrest casing housing a moving mechanism;

FIG. 9 is a horizontal sectional view of a headrest casing before movement;

FIG. 10 is a horizontal sectional view of a headrest casing after movement;

FIG. 11 is a perspective view illustrating a mode of mounting a headrest to a seat back;

FIG. 12 is a plan view of a front-rear locking mechanism according to a modification;

FIG. 13 is a rear perspective view of a front-rear locking mechanism according to the modification;

FIG. 14 is a rear perspective view of a front-rear locking mechanism according to another modification; and

FIG. 15 is a perspective view illustrating a mode of mounting a headrest to a seat back according to a modification.

#### DESCRIPTION OF EMBODIMENTS

Embodiments of the invention will now be described with reference to the accompanying drawings.

With reference to FIGS. 1 to 11, a headrest 1 according to an embodiment includes first and second headrest pillars 2a and 2b, a pair of pillar retainers 3a and 3b, a stationary unit 4, a movable unit 5, a moving mechanism, a front-rear locking mechanism, a vertical locking mechanism, and an operation unit 9. The headrest 1 also includes a headrest casing 33 that can house the upper portions of the first and second headrest pillars 2a and 2b and the other components, and a cushion pad and a covering material disposed around the headrest casing 33.

The headrest 1 is mounted to the top end of a seat back 10 of a vehicle seat.

The front, rear, upper, lower, right, and left directions in the embodiment are identical to those of the vehicle seat and the vehicle.

The first and second headrest pillars 2a and 2b extend downward from the headrest 1 and are mounted to a seat back frame 10a of the seat back 10. In other words, the

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headrest 1 is mounted to the seat back frame 10a via the first and second headrest pillars 2a and 2b.

The first and second headrest pillars 2a and 2b have the same diameter. At least one of the first and second headrest pillars 2a and 2b has multiple notches 2c, which function as the vertical locking mechanism, spaced in the longitudinal direction.

The pillar retainers 3a and 3b respectively hold the first and second headrest pillars 2a and 2b, and are vertically slidable along the first and second headrest pillars 2a and 2b.

The pillar retainers 3a and 3b each include a cylindrical base 11 to hold the first or second headrest pillar 2a or 2b, a cover 12 surrounding the cylindrical base 11, and a head 13a or 13b disposed on the top end of the cylindrical base 11.

The cylindrical bases 11 each have a through hole extending in the longitudinal direction to receive the first or second headrest pillar 2a or 2b.

The covers 12 are each fabricated by bending a metal plate into a rectangular tube, and hold the cylindrical base 11.

The heads 13a and 13b are integrated with the top ends of the respective cylindrical bases 11. The heads 13a and 13b each have a central opening in communication with the through hole of the cylindrical base 11. The head 13a, which is provided to the first headrest pillar 2a of the first and second headrest pillars 2a and 2b, is equipped with a locking unit 14 that functions as the vertical locking mechanism (described below).

The fixed unit 4 is disposed between the first and second headrest pillars 2a and 2b and is disposed over the seat back frame 10a with the first and second headrest pillars 2a and 2b.

The stationary unit 4 is vertically slidable along the first and second headrest pillars 2a and 2b.

The movable unit 5 is connected to the stationary unit 4 with the moving mechanism, and can move apart from or close to the stationary unit 4 toward the front or rear direction.

The moving mechanism connects the stationary unit 4 to the movable unit 5. Examples of the moving mechanism include a linkage. In particular, an X linkage is used in the embodiment. The X linkage includes an inside linkage segment 6 and an outside linkage segment 7 rotatably connected each other at a central connecting intersection 8.

The front-rear locking mechanism includes a lock receiver 15 and a locking component 16 engageable with the lock receiver 15, to lock or unlock the movable unit 5 movable forward or rearward relative to the stationary unit 4.

The vertical locking mechanism engages or disengages the stationary unit 4 with or from the first and second headrest pillars 2a and 2b at multiple vertical positions. The vertical locking mechanism includes the locking unit 14, as described above.

The operation unit 9 operates the front-rear locking mechanism and the vertical locking mechanism in the same direction and simultaneously. In specific, the operation unit 9 unlocks the movable unit 5 prevented from moving in the front-rear direction and also unlocks the stationary unit 4 prevented from moving in the vertical direction.

The operation direction of the operation unit 9 is set so as to be along the right-left direction. Although the operation unit 9 can be operated manually or automatically, it is operated manually in the embodiment.

The X linkage will now be described in more detail.

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The following description focuses on the detailed configurations of the stationary unit 4 and the movable unit 5.

With reference to FIGS. 1 to 6 and 8 to 11, the stationary unit 4 includes a plate-like base 4a fixed to the first and second headrest pillars 2a and 2b, and a body 4b disposed on the front surface of the base 4a and connected to the X linkage.

The base 4a is composed of a metal and has a substantially inverted T shape as viewed from the back.

The right and left portions of the substantially inverted T plate are fixed to the rear surfaces of the covers 12 of the pillar retainers 3a and 3b, respectively. The central portion of the substantially inverted T plate is fixed to the body 4b.

With reference to FIGS. 2 and 7, the base 4a is equipped, on the rear surface, with the locking component 16 of the front-rear locking mechanism, as will be described below.

The body 4b is composed of a resin, and includes a plate 20, supports 21 and 22, fixing portions 23, and reinforcing ribs 24.

The plate 20 abuts on the front surface of the base 4a and is fixed to the base 4a with the fixing portions 23.

The fixing portions 23 are integrated with the plate 20 at least at the four corners and protrude in the right-left direction of the plate 20. The fixing portions 23 are fastened to the base 4a with screws, rivets and the like.

The supports 21 and 22 are connected to the inside linkage segment 6 and the outside linkage segment 7, respectively, of the X linkage and rotatably support the inside linkage segment 6 and the outside linkage segment 7.

The supports 21 and 22 are integrated with the plate 20 at four positions along the vertical and horizontal edges, i.e., at the four corners of the plate 20. The supports 21 and 22 protrude forward from the front surface of the plate 20. In the supports 21 and 22, the supports 21 are disposed at the upper corners whereas the supports 22 are disposed at the lower corners.

The supports 21 and 22 each have a width in the right-left direction larger than its thickness in the front-rear direction (the depth of the forward protrusion). Such wide supports 21 and 22 have high stiffness.

The upper supports 21 each have an opening extending in the right-left direction to receive a coupling rod 47 (described below). The openings of the upper supports 21 are circular holes.

The lower supports 22 each have a larger height in the vertical direction than that of the upper supports 21.

The lower supports 22 each have an opening extending in the right-left direction to receive a coupling rod 58 (described below). The openings of the lower supports 22 are holes vertically elongated along the lower supports 22.

The upper supports 21 and the lower supports 22 are integrated with reinforcing ribs 24 disposed therebetween. The reinforcing ribs 24 are disposed along the respective vertical edges of the plate 20 and connect the right and left outer ends of the upper supports 21 to the right and left outer ends of the lower supports 22, to define lateral walls of the body 4b.

The reinforcing ribs 24 are integrated with the plate 20 at the rear edges, the upper supports 21 at the upper edges, and the lower supports 22 at the lower edges. The reinforcing ribs 24 each have a front recessed edge 26 recessed rearward.

The upper fixing portions 23 aligned above the other fixing portions 23 are disposed at a height different from that of the upper supports 21. According to the embodiment, the upper fixing portions 23 are disposed at a height substantially equal to that of the reinforcing ribs 24. In other words,

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the upper fixing portions **23** reside at a height between the upper and lower ends of the reinforcing ribs **24**.

Although the height of the upper fixing portions **23** differs from that of the upper supports **21** to facilitate the fixation of the body **4b** to the base **4a** and the insertion of the coupling rod **47** (described below) to the circular openings according to the embodiment, this configuration should not be construed to limit the invention. The upper fixing portions **23** may also be disposed at a height substantially equal to that of the upper supports **21** to increase the stiffness of the stationary unit **4**, which feature is not shown.

The lower fixing portions **23** aligned below the upper fixing portions **23** are disposed at a height substantially equal to that of the lower supports **22**. In other words, the lower fixing portions **23** reside at a height between the upper and lower ends of the lower supports **22**.

The body **4b** and the supports **21** and **22** are disposed behind a virtual line V1 connecting the axial centers of the first and second headrest pillars **2a** and **2b**.

The first and second headrest pillars **2a** and **2b** are disposed apart from each other and thus have a space therebetween. The space can accommodate the body **4b** and the supports **21** and **22** because the base **4a** is fixed to the rear surfaces of the pillar retainers **3a** and **3b**.

The stationary unit **4** further has a clearance **17** at a position corresponding to the lock receiver **15**. In specific, the lock receiver **15** is configured to protrude rearward from the stationary unit **4**, as will be described below. The clearance **17** of the stationary unit **4** allows the lock receiver **15** to protrude rearward.

The clearance **17** according to the embodiment is a through hole extending through the stationary unit **4** in the front-rear direction, and is composed of a base opening **17a** provided in the base **4a** and a body opening **17b** provided in the body **4b**.

Although the clearance **17** is a through hole according to the embodiment, this configuration should not be construed to limit the invention. The clearance **17** may also be a rearward protrusion having an internal space.

The stationary unit **4** further includes a holder **18** to slidably hold a first shaft segment **60** of the operation unit **9**.

The stationary unit **4** further includes a limiter **19** which limits the movable range of the locking component **16**.

With reference to FIGS. **1** to **6** and **8** to **11**, the movable unit **5** is disposed adjacent to the head of an occupant, and can move forward or rearward relative to the stationary unit **4**, as described above. The movable unit **5** is composed of a resin, and includes a recessed portion **30**, supports **31** and **32**, and a headrest casing **33**.

The recessed portion **30** is a plate opposed to the plate **20** of the stationary unit **4**. The recessed portion **30** has a height in the vertical direction and a width in the right-left direction substantially equal to the height and the width, respectively, of the plate **20**.

The recessed portion **30** is centered in the width direction of the movable unit **5** and is bowed rearward. In other words, the recessed portion **30** of the movable unit **5**, which is disposed adjacent to the head of the occupant, has a shape suitable for the back of the head of the occupant.

The supports **31** and **32** are connected to the outside linkage segment **7** and the inside linkage segment **6**, respectively, of the x linkage and rotatably support the outside linkage segment **7** and the inside linkage segment **6**.

The supports **31** and **32** are integrated with the recessed portion **30** at four positions along the vertical and horizontal edges, i.e., at the four corners of the recessed portion **30**. The supports **31** and **32** protrude rearward from the rear surface

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of the recessed portion **30**. In the supports **31** and **32**, the supports **31** are disposed at the upper corners whereas the supports **32** are disposed at the lower corners.

The supports **31** and **32** each have a width in the right-left direction larger than its thickness in the front-rear direction (the depth of the rearward protrusion). Such wide supports **31** and **32** have high stiffness.

The upper supports **31** each have a circular opening to receive a coupling rod **57** (described below), as in the stationary unit **4**. The lower supports **32** also each have an elongated opening to receive a coupling rod **48** (described below). The elongated openings of the lower supports **32** have a longer vertical length than that of the circular openings of the upper supports **31**.

The supports **31** and **32** protrude rearward whereas the recessed portion **30** is bowed rearward so as to be recessed, as described above. The depth of the rearward bend (rearward protrusion) of the recessed portion **30** is smaller than that of the rearward protrusion of the supports **31** and **32**. In other words, the back face of the recessed portion **30** disposed within the depth of the rearward protrusion of the supports **31** and **32**.

The upper supports **31** and the lower supports **32** have spaces therebetween, instead of ribs like the reinforcing ribs **24** of the stationary unit **4**. In other words, the upper supports **31**, the lower supports **32**, and the recessed portion **30** define, between the upper supports **31** and the lower supports **32**, a recessed area **36** having a concave shape as viewed from the side.

With reference to FIGS. **8** to **10**, the headrest casing **33** is a hollow housing composed of a front segment **34** and a rear segment **35** and surrounded by the cushion pad.

The front segment **34** has a front face **34a** and a periphery **34b** extending rearward from the circumferential edge of the front face **34a**. The front face **34a** is integrated with the recessed portion **30**.

The rear segment **35** has a rear face **35a** and a periphery **35b** extending forward from the circumferential edge of the rear face **35a**. The periphery **35b** of the rear segment **35** is assembled to the periphery **34b** of the front segment **34** to form the headrest casing **33**.

The periphery **35b** can be assembled to the periphery **34b** with any known technique without being limited to the embodiment.

The periphery **34b** and the periphery **35b** respectively have notches **34c** and **35c** in the bottoms to receive the first and second headrest pillars **2a** and **2b**. The notches **34c** and **35c** each form the half of an elongated hole. In the assembly of the periphery **34b** and the periphery **35b**, the notches **34c** and **35c** define two elongated holes in the bottom of the headrest casing **33**.

The two elongated holes in the bottom of the headrest casing **33** are oriented such that the longitudinal direction of the elongated holes accords with the direction of the front-rear movement of the movable unit **5**.

The headrest casing **33** further has a slit in a side face to allow the outward protrusion of one end of the operation unit **9**, which feature is not shown. This slit is also composed of respective notches in the front segment **34** and the rear segment **35**, each of which forms the half of the slit, like the notch **34c** or **35c**.

The portion of the operation unit **9** protruding from the side face of the headrest casing **33** can thus be directly operated when the operation unit **9** is operated.

With reference to FIGS. **1** to **6**, the inside linkage segment **6** of the X linkage is disposed adjacent to the stationary unit **4** at the upper end and to the movable unit **5** at the lower end.

The outside linkage segment 7 is disposed adjacent to the movable unit 5 at the upper end and to the stationary unit 4 at the lower end.

These orientations of the inside linkage segment 6 and the outside linkage segment 7 may be inverted.

The upper end of the inside linkage segment 6 is disposed between the right and left upper supports 21 of the stationary unit 4.

The lower end of the outside linkage segment 7 is disposed between the right and left lower supports 22 of the stationary unit 4.

The lower end of the inside linkage segment 6 is disposed between the right and left lower supports 32 of the movable unit 5.

The upper end of the outside linkage segment 7 is disposed between the right and left upper supports 31 of the movable unit 5.

With reference to FIGS. 3 and 5, the inside linkage segment 6 and the outside linkage segment 7 each have a bent shape as viewed from the side. In specific, the inside linkage segment 6 and the outside linkage segment 7 are each bent while being curved forward.

In more detailed description with reference to FIG. 3, the portion of the inside linkage segment 6 above the central intersection 8 is curved rearward whereas the portion of the inside linkage segment 6 below the connecting intersection 8 is curved forward. In other words, the inside linkage segment 6 generally has a substantially S shape as viewed from the side. It is noted that the portion of the inside linkage segment 6 below the connecting intersection 8 slightly extends downward.

In contrast, the outside linkage segment 7 is bent in the vicinity of the central connecting intersection 8 while being generally curved forward. In other words, the outside linkage segment 7 generally has a substantially L shape as viewed from the side.

The inside linkage segment 6 and the outside linkage segment 7 are rotatably connected each other at the central connecting intersection 8, as described above.

In general, an X linkage inevitably has a crossing of one link and the other. The connecting intersection 8 is thus disposed at the crossing of the inside linkage segment 6 and the outside linkage segment 7, which inevitably exists in the X linkage.

With reference to FIGS. 3 and 5, the connecting intersection 8 resides on a virtual line V2 connecting the upper and lower ends of the inside linkage segment 6 and a virtual line V3 connecting the upper and lower ends of the outside linkage segment 7.

The connecting intersection 8 is disposed in a space defined by the recessed edges 26 of the stationary unit 4 and the recessed area 36 of the movable unit 5. In other words, the recessed edges 26 and the recessed area 36 can avoid the interference of the stationary unit 4 and the movable unit 5, respectively, with the connecting intersection 8 during the rearward movement of the movable unit 5.

The connecting intersection 8 is disposed in the forward-most portion of the inside linkage segment 6 and in the rearmost portion of the outside linkage segment 7.

In other words, the inside linkage segment 6 has forward protrusions 8a in the vicinity of the center of the inside linkage segment 6, whereas the outside linkage segment 7 has rearward protrusions 8b in the vicinity of the center of the outside linkage segment 7. In specific, the protrusions 8a are integrated with the inside linkage segment 6 and protrude forward from near the centers of side walls 43 (described below). The protrusions 8b are integrated with the

outside linkage segment 7 and protrude rearward from near the centers of side walls 53 (described below).

The connecting intersection 8 indicates the portion including the side walls 43 (described below) and the protrusions 8a of the inside linkage segment 6, and the side walls 53 (described below) and the protrusions 8b of the outside linkage segment 7.

The side walls 43 and 53 (described below) in the connecting intersection 8 each have a circular opening extending through the side wall 43 or 53 in the right-left direction. The circular openings are opposed to each other and receive a metal connector Sc. The inside linkage segment 6 and the outside linkage segment 7 are thus rotatably connected each other with the connector 8c functioning as a pivot.

The ends of the connector 8c protrude outward from the respective lateral surfaces of the outside linkage segment 7. The protruding ends of the connector 8c are disposed in the space defined by the recessed edges 26 and the recessed area 36.

The inside linkage segment 6 according to the embodiment includes a first arm 40 and a second arm 41, which have connections 42. In other words, the inside linkage segment 6 according to the embodiment is composed of two arms 40 and 41.

The first arm 40 and the second arm 41 are spaced from each other symmetrically in the right-left direction and face the same direction. The space between the first arm 40 and the second arm 41 receives the lock receiver 15, as will be described below. The position of the space between the first arm 40 and the second arm 41 corresponds to the positions of the base opening 17a and the body opening 17b constituting the clearance 17.

The first arm 40 and the second arm 41 each have right and left side walls 43, a central wall 44 connecting the respective side walls 43, end walls 45 at the upper and lower ends, and ribs as reinforcements 46 perpendicular to the longitudinal direction of the first arm 40 or the second arm 41.

The side walls 43, the central wall 44, the end walls 45, and the reinforcements 46 are integrated with one another.

The central wall 44 connects the rear edges of the right and left side walls 43 and the rear edges of the upper and lower end walls 45.

The connections 42 each indicate the upper end of the first arm 40 or the second arm 41 connected to and supported by the upper support 21 of the stationary unit 4 or the lower end of the first arm 40 or the second arm 41 connected to and supported by the lower support 32 of the movable unit 5.

The upper ends of the right and left side walls 43, which function as the upper connection 42 of the first arm 40 or the second arm 41, each have a circular opening. The openings are opposed to each other, and one of the openings is opposed to the circular opening of the upper support 21.

The circular openings of the upper supports 21 and the circular openings of the upper connections 42 receive a metal coupling rod 47. The first arm 40 and the second arm 41 are thus rotatably connected to the stationary unit 4 with the coupling rod 47 functioning as a pivot.

The lower ends of the right and left side walls 43, which function as the lower connection 42 of the first arm 40 or the second arm 41, also each have a circular opening.

The elongated openings of the lower supports 32 and the circular openings of the lower connections 42 receive a metal coupling rod 48. The first arm 40 and the second arm 41 are thus rotatably connected to the movable unit 5 with the coupling rod 48 functioning as a pivot.

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The coupling rod **48** is vertically slidable along the elongated openings. The lower ends of the first arm **40** and the second arm **41** are thus vertically slidable along the lower supports **32** in response to the front-rear movement of the movable unit **5**.

The outside linkage segment **7** according to the embodiment includes a first arm **50** and a second arm **51**, which have connections **52**. In other words, the outside linkage segment **7** according to the embodiment is composed of two arms **50** and **51**.

The first arm **50** and the second arm **51** are symmetrical in the right-left direction and are integrated with each other with no space therebetween.

The joint between the first arm **50** and the second arm **51** is integrated with the lock receiver **15**, as will be described below. In other words, the outside linkage segment **7** is integrated with the lock receiver **15**.

The first arm **50** and the second arm **51** each have right and left side walls **53**, a central wall **54** disposed in the center between the respective side walls **53**, and further ribs as reinforcements **56** perpendicular to the longitudinal direction of the first arm **50** or the second arm **51**.

The side walls **53**, the central wall **54**, and the reinforcements **56** are integrated with one another.

The central wall **54** connects the rear edges of the right and left side walls **53**, and is disposed above the connecting intersection **8**.

The connections **52** each indicate the upper end of the first arm **50** or the second arm **51** connected to and supported by the lower support **22** of the stationary unit **4** or the lower end of the first arm **50** or the second arm **51** connected to and supported by the upper support **31** of the movable unit **5**.

The upper ends of the right and left side walls **53**, which function as the upper connection **52** of the first arm **50** or the second arm **51**, each have a circular opening. The openings are opposed to each other, and one of the openings is opposed to the circular opening of the upper support **31**.

The circular openings of the upper supports **31** and the circular openings of the upper connections **52** receive a metal coupling rod **57**. The first arm **50** and the second arm **51** are thus rotatably connected to the movable unit **5** with the coupling rod **57** functioning as a pivot.

The lower ends of the right and left side walls **53**, which function as the lower connection **52** of the first arm **50** or the second arm **51**, also each have a circular opening.

The elongated openings of the lower supports **22** and the circular openings of the lower connections **52** receive a metal coupling rod **58**. The first arm **50** and the second arm **51** are thus rotatably connected to the stationary unit **4** with the coupling rod **58** functioning as a pivot.

The coupling rod **58** is vertically slidable along the elongated openings. The lower ends of the first arm **50** and the second arm **51** are thus vertically slidable along the lower supports **22** in response to the front-rear movement of the movable unit **5**.

The lock receiver **15**, which is integrated with the outside linkage segment **7**, functions as the front-rear locking mechanism (described below). The lock receiver **15** protrudes rearward from the rear surface of the outside linkage segment **7**.

The lock receiver **15** passes through the space between the first arm **40** and the second arm **41** of the inside linkage segment **6** and then through the body opening **17b** and the base opening **17a** of the clearance **17** during the rearward movement of the movable unit **5** toward the stationary unit **4**.

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The lock receiver **15** is supported by the connector **8c** provided in the connecting intersection **8**. In specific, the connector **8c** has an outer diameter substantially equal to the inner diameter of the circular openings in the connecting intersection **8** such that the connector **8c** can rotate in the circular openings, and thus can support the lock receiver **15**.

With reference to FIG. **6**, the front ends of the side walls **53** of the outside linkage segment **7** integrated with the lock receiver **15** function as an abutting portion **59**, which abuts on the back face of the recessed portion **30** of the movable unit **5**. In other words, the X linkage has the abutting portion **59** abutting on the back face of the recessed portion **30**.

The back face of the recessed portion **30** is disposed within the depth of the rearward protrusion of the supports **31** and **32**, as described above. The abutting portion **59**, which abuts on the back face of the recessed portion **30**, is thus also disposed within the depth of the rearward protrusion of the supports **31** and **32**.

With reference to FIGS. **1** to **6**, the ends of the inside linkage segment **6** and the outside linkage segment **7** adjacent to the movable unit **5** are also disposed within the depth of the rearward protrusion of the supports **31** and **32**. The ends of the inside linkage segment **6** and the outside linkage segment **7** adjacent to the stationary unit **4** are disposed within the depth of the forward protrusion of the supports **21** and **22** of the stationary unit **4**.

At least one of the inside linkage segment **6** and the outside linkage segment **7** has a substantially U-shaped cross section.

According to the embodiment, the inside linkage segment **6** and the outside linkage segment **7** include the first arms **40** and **50** and the second arms **41** and **51**, respectively, and thus both have substantially U-shaped cross sections.

The first arm **50** and the second arm **51** of the outside linkage segment **7** each include right and left side walls **53**. The left side wall **53** of the first arm **50** and the right side wall **53** of the second arm **51** respectively serve as the left and right lateral surfaces of the outside linkage segment **7**.

The distance between the left side wall **53** of the first arm **50** and the right side wall **53** of the second arm **51** is larger than the width of the inside linkage segment **6** in the right-left direction. With reference to FIG. **3**, the inside linkage segment **6** is at least partially accommodated in the space between the left side wall **53** of the first arm **50** and the right side wall **53** of the second arm **51** of the outside linkage segment **7** after the rearward movement of the movable unit **5**.

The reinforcements **46** and **56** are opposed to the connecting intersection **8**. The reinforcements **46** and **56** are also each opposed to the connection **42** or **52** of the inside linkage segment **6** or the outside linkage segment **7** connected to the stationary unit **4**, or the connection **42** or **52** of the inside linkage segment **6** or the outside linkage segment **7** connected to the movable unit **5**.

In specific, the reinforcements **46** and **56** each face the connection **42** or **52**. The reinforcements **46** and **56** are disposed along the longitudinal direction of the coupling rods **47**, **48**, **57**, and **58** perpendicular to the longitudinal direction of the first arms **40** and **50** and the second arms **41** and **51**.

The reinforcements **46** and **56** disposed adjacent to the connections **42** and **52**, respectively, as described above, are preferred to effectively reinforce the connections **42** and **52**.

The front-rear locking mechanism will now be described in more detail.

The front-rear locking mechanism is disposed in the space between the first and second headrest pillars **2a** and **2b**. The

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front-rear locking mechanism can thus be disposed in the vicinity of the first and second headrest pillars **2a** and **2b**.

The stationary unit **4** is equipped with the locking component **16** of the front-rear locking mechanism on the rear surface and with the X linkage on the front surface.

The following description focuses on the detailed configuration of the lock receiver **15**.

The lock receiver **15** of the front-rear locking mechanism is integrated with the outside linkage segment **7**, as described above. The lock receiver **15** is disposed in the center between the first and second headrest pillars **2a** and **2b**. The lock receiver **15** is integrated with the rear ends of the right side wall **53** of the first arm **50** and the left side wall **53** of the second arm **51** of the outside linkage segment **7**, and protrudes rearward.

In other words, the outside linkage segment **7** is also disposed in the center between the first and second headrest pillars **2a** and **2b**. The inside linkage segment **6**, the stationary unit **4**, and the movable unit **5** are thus also disposed in the center between the first and second headrest pillars **2a** and **2b**.

With reference to FIGS. **2**, **3**, and **5**, the lock receiver **15** protrudes rearward from the stationary unit **4** in response to the rearward movement of the movable unit **5**. The lock receiver **15** is thus disposed behind the first and second headrest pillars **2a** and **2b** after the rearward movement of the movable unit **5**.

The disposition of the lock receiver **15** behind the first and second headrest pillars **2a** and **2b** is achieved by the clearance **17** of the stationary unit **4**.

The lock receiver **15** includes a ratchet mechanism having multiple teeth **70**, which are arranged on an arc line corresponding to the rotation of the X linkage. The teeth **70** are integrated with the lock receiver **15**.

With reference to FIGS. **3** and **5**, the lock receiver **15** has an upper surface **71** extending rearward from the upper ends of the side walls **53** integrated therewith along an arc profile curved upward (or rearward). The lock receiver **15** has a bottom surface **72** extending rearward from lower central portions of the side walls **53** along an arc profile curved upward. The arc profile of the upper surface **71** is gentler than that of the bottom surface **72**. The lock receiver **15** is tapered rearward and extends downward. In other words, the lock receiver **15** has a substantially tongue shape as viewed from the side.

The lock receiver **15** thus can protrude rearward from the stationary unit **4** in response to the rearward movement of the movable unit **5**.

The teeth **70** are disposed on the upper surface **71** of the lock receiver **15**. The teeth **70** each have a substantially triangle shape as viewed from the side.

The arc upper surface **71** has a curvature corresponding to the rotation of the outside linkage segment **7**. The arrangement of the teeth **70** on the upper surface **71** thus also corresponds to the rotation of the outside linkage segment **7**.

Accordingly, the teeth **70** travel along a certain path. The locking component **16**, which is disposed in the path of the teeth **70**, can thus lock the movable unit **5** movable forward or rearward.

The following description focuses on the detailed configuration of the locking component **16**.

The locking component **16** of the front-rear locking mechanism is mounted on the rear surface of the base **4a** of the stationary unit **4**.

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With reference to FIGS. **2** and **7**, the locking component **16** can be moved with the operation unit **9** in the right-left direction to engage with or separate from the lock receiver **15**.

In specific, the rear surface of the base **4a** of the stationary unit **4** is integrated with a metal rod **75** protruding rearward at a position above the clearance **17**. The rod **75** swingably supports the locking component **16** while allowing the locking component **16** to move in the right-left direction.

The locking component **16** is operated with the operation unit **9**, as described above. In particular, the locking component **16** is operated with the first shaft segment **60** of the operation unit **9**.

With reference to FIG. **7**, the locking component **16** has a contact **76** to receive the tip of the first shaft segment **60**. The locking component **16** is integrated with the contact **76** at the lateral end adjacent to the operation unit **9**.

The locking component **16** can separate from the lock receiver **15** in response to the shift of the contact **76** caused by the rightward movement of the first shaft segment **60**.

The movable range of the locking component **16** is limited by the limiter **19**, as described above. In other words, the stationary unit **4** includes a limiter **19** to limit the movable range of the locking component **16**. The locking component **16** includes a restricting rod **77** that slides along and only in the limiter **19**.

With reference to FIG. **7**, the limiter **19** is an arc groove provided in the base **4a** of the stationary unit **4**. The restricting rod **77** is integrated with the front surface of the locking component **16** and is inserted in the groove serving as the limiter **19**. The locking component **16** thus can swing in the right-left direction within the range corresponding to the sliding of the restricting rod **77** between one end and the other end of the limiter **19**.

The locking component **16** further has a flange **78** at the lateral end distant from the operation unit **9**.

The flange **78** is integrated with the locking component **16** and extends along the edge of the locking component **16** distant from the operation unit **9**.

The flange **78** should preferably be disposed in the vicinity of the rod **75** of the locking component **16**, which often undergoes stress from various directions.

The vertical locking mechanism will now be described in more detail.

The vertical locking mechanism is provided to the first and second headrest pillars **2a** and **2b** to engage or disengage the stationary unit **4** with or from the first and second headrest pillars **2a** and **2b** at multiple vertical positions.

The vertical locking mechanism includes the pillar retainers **3a** and **3b** and the notches **2c** on the first and/or second headrest pillar(s) **2a** and/or **2b**.

The locking unit **14** mounted on the head **13a** of the pillar retainer **3a** engages with the notches **2c** formed on at least one of the first and second headrest pillars **2a** and **2b**.

According to the embodiment, the notches **2c** are formed on the first headrest pillar **2a**, which is held by the pillar retainer **3a** equipped with the locking unit **14** in the pillar retainers **3a** and **3b**.

The notches **2c** reside at multiple positions along the longitudinal direction of the first headrest pillar **2a**. The notches **2c** are disposed on the periphery of the first headrest pillar **2a** on the right of the axial center.

The locking unit **14** is disposed on the left of the head **13a**. The locking unit **14** includes a retainer **14a** to hold the tip of a second shaft segment **61** of the operation unit **9**. The

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locking unit **14** moves in the right-left direction relative to the head **13a** in response to an operation of the operation unit **9**.

The locking unit **14** further includes an engaging member (not shown) engageable with one of the notches **2c** inside the head **13a**, and a biasing member (not shown) for urging the engaging member to engage with the notch **2c**.

The engaging member is a ring and has a central opening that receives the first headrest pillar **2a**, which feature is not shown. The engaging member can move in the right-left direction in response to an operation of the operation unit **9**.

The engaging member engages with the notch **2c** inside the head **13a** due to the biasing force of the biasing member in a standby mode. In contrast, the engaging member disengages from the notch **2c** inside the head **13a** in response to the operation.

In other words, the vertically movable pillar retainer **3a** is locked in the standby mode of the locking unit **14**, and is unlocked in response to the push of the locking unit **14** toward the first headrest pillar **2a**.

The biasing member is a flexible component, such as a compressed spring and the like, which urges the engaging member to move apart from the first headrest pillar **2a** (in the leftward direction in the embodiment).

Although the engaging member is urged by the biasing member to move apart from the first headrest pillar **2a**, the engaging member receives the first headrest pillar **2a** in the central hole of the engaging member. Thus, the portion of the engaging member on the right of the central hole engages with the notch **2c**.

The vertical locking mechanism having such a configuration can engage or disengage the stationary unit **4** with or from the first and second headrest pillars **2a** and **2b** at multiple vertical positions, i.e., the positions of the notches **2c**.

Although the locking unit **14** includes the engaging member and the biasing member according to the embodiment, this configuration should not be construed to limit the invention. In specific, the locking unit **14** may be any other unit that can operate in response to an operation of the operation unit **9** to engage or disengage the stationary unit **4** with or from the first and second headrest pillars **2a** and **2b** at multiple vertical positions.

The operation unit **9** will now be described in more detail.

With reference to FIGS. **2**, **4**, and **6**, the operation unit **9** has a substantially J shape, and includes a first shaft segment **60**, a second shaft segment **61**, and a connecting shaft segment **62**. The first shaft segment **60** and the second shaft segment **61** move in the same direction together with the connecting shaft segment **62**.

The first shaft segment **60**, the second shaft segment **61**, and the connecting shaft segment **62** are integrated with one another. In other words, the operation unit **9** is fabricated by bending a single metal shaft.

The first shaft segment **60** operates the locking component **16** to unlock the front-rear locking mechanism, as described above. Since the tip of the first shaft segment **60** abuts on the contact **76** of the locking component **16**, the right-left movement of the first shaft segment **60** can swing the locking component **16** in the right-left direction.

The first shaft segment **60** is parallel to the second shaft segment **61** and is longer than the second shaft segment **61**.

The first shaft segment **60** is disposed behind the stationary unit **4**, and thus does not inhibit the movement of the X linkage disposed in front of the stationary unit **4**.

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The stationary unit **4** includes a holder **18** to slidably hold the first shaft segment **60**, as described above. The holder **18** can reduce vibrations of the first shaft segment **60** moving in the right-left direction.

In specific, the holder **18** has a through hole extending through the holder **18** in the right-left direction. The through hole receives the first shaft segment **60**. The inner diameter of the through hole is substantially equal to the outer diameter of the first shaft segment **60** such that the first shaft segment **60** can slide in the through hole in the right-left direction.

The second shaft segment **61** operates the locking unit **14** to unlock the vertical locking mechanism, as described above. Since the tip of the second shaft segment **61** is held by the retainer **14a** of the locking unit **14**, the right-left movement of the second shaft segment **61** can shift the locking unit **14** in the right-left direction.

The second shaft segment **61** is substantially parallel to the first shaft segment **60** and is shorter than the first shaft segment **60**.

The locking component **16** of the front-rear locking mechanism is disposed at a height substantially equal to that of the locking unit **14** for locking or unlocking the vertical locking mechanism. The first shaft segment **60** and the second shaft segment **61** are thus disposed at substantially the same height.

According to the embodiment, the operation unit **9** is oriented such that the first shaft segment **60** and the second shaft segment **61** are aligned in parallel in the horizontal direction.

The connecting shaft segment **62** connects one end of the first shaft segment **60** to one end of the second shaft segment **61**. An operation of the connecting shaft segment **62** in the right-left direction can move the first shaft segment **60** and the second shaft segment **61** together in the right-left direction.

Accordingly, a direct operation of the connecting shaft segment **62** can unlock both the front-rear locking mechanism and the vertical locking mechanism. In specific, the push of the connecting shaft segment **62** rightward, i.e., in the axial direction of the first shaft segment **60** and the second shaft segment **61**, can unlock both the front-rear locking mechanism and the vertical locking mechanism.

With reference to FIG. **6**, the connecting shaft segment **62** is integrated with an operational plate **63** having a diameter larger than the distance between the respective axial centers of the first shaft segment **60** and the second shaft segment **61**. The operational plate **63** according to the embodiment is a metal disk.

The operational plate **63** integrated with the connecting shaft segment **62** can readily transmit the pushing force on the operation unit in the axial direction of the first shaft segment **60** and the second shaft segment **61** to the first shaft segment **60** and the second shaft segment **61**.

Although the operational plate **63** has a diameter larger than the distance between the respective axial centers of the first shaft segment **60** and the second shaft segment **61** according to the embodiment, this configuration should not be construed to limit the invention. For example, the operational plate **63** may be replaced with a button protruding outward from the surface of the cushion pad.

The front-rear locking mechanism and the vertical locking mechanism are unlocked through the rightward push of the connecting shaft segment **62**, and are locked through stopping the rightward push of the connecting shaft segment **62** and thus returning the operation unit **9** to the original position.



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In specific, the locking unit **14** includes the biasing member, as described above. The biasing force of the biasing member returns the operation unit **9** to the original position.

The biasing member of the locking unit **14** may be replaced with any other biasing member that can return the operation unit **9** to the original position. For example, the holder **18** that holds the first shaft segment **60** may include a biasing member to return the first shaft segment **60** to the original position.

The mode of mounting the headrest **1** to the seat back frame **10a** will now be described.

According to the embodiment, the seat back frame **10a** is equipped with a pair of holders **80** at the upper end, as illustrated in FIG. **11**. The holders **80** respectively hold the first and second headrest pillars **2a** and **2b**.

The first and second headrest pillars **2a** and **2b** are vertically slidable relative to the respective holders **80** and can be vertically moved, and thus the positions of the first and second headrest pillars **2a** and **2b** can be stepwise adjusted.

The holders **80** each include a cylindrical base **81** to hold the first or second headrest pillar **2a** or **2b**, a cover **82** surrounding the cylindrical base **81**, and a head **83** integrated with the top end of the cylindrical base **81**.

The heads **83** are each provided with a lock **84** to prevent the extraction of the first or second headrest pillar **2a** or **2b**.

The cylindrical bases **81** each have a through hole extending in the longitudinal direction to receive the first or second headrest pillar **2a** or **2b**.

The covers **82** are each fabricated by bending a metal plate into a rectangular tube, and hold the cylindrical base **81**. The covers **82** are fixed to the seat back frame **10a**.

The heads **83** each have a central opening in communication with the through hole of the cylindrical base **81**. The heads **83** are exposed from the top end of the seat back **10**.

The locks **84** have the same function as that of the locking unit **14**. In other words, the push of the locks **84** can unlock the pillars. The locks **84** return to the original positions in response to the stop of the push, and can lock the first and second headrest pillars **2a** and **2b** to prevent the movement of the first and second headrest pillars **2a** and **2b** in the extraction direction.

The first and second headrest pillars **2a** and **2b** are each provided with multiple notches **2d** engageable with the lock **84**. The first and second headrest pillars **2a** and **2b** can be shifted to multiple vertical positions corresponding to the respective notches **2d**. In other words, the first and second headrest pillars **2a** and **2b** include another vertical locking mechanism in addition to the pillar retainers **3a** and **3b**, so that the position of the headrest **1** can be adjusted more finely.

The holders **80** are disposed such that the locks **84** face the center between the first and second headrest pillars **2a** and **2b**.

The notches **2d** are thus formed on the peripheries of the first and second headrest pillars **2a** and **2b** on their outer sides. In other words, the first headrest pillar **2a** has notches **2d** on the left-side periphery whereas the second headrest pillar **2b** has notches **2d** on the right-side periphery.

The notches **2d** on the periphery of the first headrest pillar **2a** thus face the direction opposite to the notches **2c**.

The operations of the headrest **1** having the above-described configuration will now be explained.

The operations of the headrest **1** include the forward movement of the movable unit **5** apart from the stationary unit **4** and the rearward returning movement of the movable

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unit **5** close to the stationary unit **4** from the position apart from the stationary unit **4**. The operations of the headrest **1** also include the vertical movement of the pillar retainers **3a** and **3b** along the respective first and second headrest pillars **2a** and **2b**.

The following explanation focuses on the movement of the movable unit **5**.

FIG. **9** illustrates the movable unit **5** closest to the stationary unit **4**, i.e., after the reward returning movement, as mentioned above. In the standby mode of the operation unit **9**, the lower end of the locking component **16** engages with one of the teeth **70** of the lock receiver **15** to lock the movable unit **5** movable forward or rearward.

In order to move such a movable unit **5** forward apart from the stationary unit **4**, the connecting shaft segment **62** of the operation unit **9** is pushed toward the first headrest pillar **2a** to move the first shaft segment **60** rightward, thereby swinging the locking component **16** rightward via the contact **76**, as illustrated in FIG. **7**.

This operation makes the lower end of the locking component **16** separated from the tooth **70** of the lock receiver **15**, and can thus disengage the locking component **16** to allow the movable unit **5** to move in the front-rear direction.

The movable unit **5** is then moved forward apart from the stationary unit **4** while the locking component **16** remains inclined rightward.

The lock receiver **15** rotates forward in conjunction with the rotation of the outside linkage segment **7**. The coupling rod **48** in the inside linkage segment **6** and the coupling rod **58** in the outside linkage segment **7** slide upward along the respective elongated openings of the lower supports **32** and **22** in conjunction with the rotation of the inside linkage segment **6** and the outside linkage segment **7**.

In response to the stop of the push operation of the operation unit **9** at any state, the locking component **16** swings leftward to the original position to engage with another one of the teeth **70** of the lock receiver **15**. This operation can move the movable unit **5** forward apart from the stationary unit **4** and then lock the movable unit **5** at a desired position, as illustrated in FIG. **10**.

It is noted that the locking component **16** may come into contact with the side face of a tooth **70** instead of fitting in the valley between adjacent teeth **70** during the operation. In such a case, the movable unit **5** should be slightly shifted forward or rearward with no operation of the operation unit **9**. The locking component **16** then enters the nearest valley and thus can lock the movable unit **5**.

In order to move the movable unit **5** rearward, the connecting shaft segment **62** of the operation unit **9** is also pushed to move the first shaft segment **60**, thereby disengaging the locking component **16**.

The push operation of the operation unit **9** is then stopped after the rearward movement of the movable unit **5** to any position or the position illustrated in FIG. **9**. The lock receiver **15** and the X linkage each move in the opposite direction compared to that in the forward movement of the movable unit **5**.

Accordingly, the movable unit **5** can be moved in the front-rear direction adjustably to multiple positions corresponding to the arrangement of the teeth **70** of the lock receiver **15**. The position of the headrest **1** can thus be adjusted stepwise in the front-rear direction.

The following explanation focuses on the movement of the pillar retainers **3a** and **3b**.

FIG. **1** illustrates the pillar retainers **3a** and **3b** disposed in respective lower portions of the first and second headrest pillars **2a** and **2b**. In the standby mode of the operation unit

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9, the engaging member of the locking unit 14 engages with one of the notches 2c in the lower portion of the first headrest pillar 2a, to lock the pillar retainers 3a and 3b so as not to move vertically.

In order to move such pillar retainers 3a and 3b upward along the first and second headrest pillars 2a and 2b, respectively, the connecting shaft segment 62 of the operation unit 9 is pushed toward the first headrest pillar 2a to move the second shaft segment 61 rightward, thereby shifting the engaging member of the locking unit 14 rightward via the retainer 14a.

This operation moves the engaging member of the locking unit 14 apart from the notch 2c of the first headrest pillar 2a, and can thus disengage the engaging member of the locking unit 14 to allow the pillar retainers 3a and 3b to move in the vertical direction.

The pillar retainers 3a and 3b are then moved upward along the first and second headrest pillars 2a and 2b, respectively, while the engaging member of the locking unit 14 remains at the rightward shifted position.

The components, such as the stationary unit 4, the movable unit 5, and the X linkage, are shifted upward in conjunction with the movement of the pillar retainers 3a and 3b.

In response to the stop of the operation of the operation unit 9 at any state, the engaging member of the locking unit 14 returns leftward to the original position due to the biasing force of the biasing member, to engage with another one of the notches 2c in an upper portion of the first headrest pillar 2a. This operation can move the pillar retainers 3a and 3b upward along the first and second headrest pillars 2a and 2b, respectively, and then lock the pillar retainers 3a and 3b at desired positions, as illustrated in FIG. 4.

It is noted that the engaging member of the locking unit 14 may come into contact with a portion of the periphery of the first headrest pillar 2a between adjacent upper and lower notches 2c during the operation. In such a case, the pillar retainers 3a and 3b should be slightly shifted upward or rearward with no operation of the operation unit 9. The engaging member then engages with the nearest notch 2c and thus can lock the pillar retainers 3a and 3b.

In order to move the pillar retainers 3a and 3b downward, the connecting shaft segment 62 of the operation unit 9 is also pushed to move the second shaft segment 61, thereby disengaging the engaging member of the locking unit 14.

The push operation of the operation unit 9 is then stopped after the downward movement of the pillar retainers 3a and 3b to any position or the position illustrated in FIG. 1. The components, such as the stationary unit 4, the movable unit 5, and the X linkage, are also shifted downward in conjunction with the movement of the pillar retainers 3a and 3b.

Accordingly, the pillar retainers 3a and 3b can be moved in the vertical direction adjustably to multiple positions corresponding to the respective notches 2c of the first headrest pillar 2a. The headrest 1 can thus be shifted adjustably to multiple vertical positions.

The above embodiments should not be construed to limit the invention, and can be modified without departing from the gist of the invention. Some modifications will now be described below.

[Modification 1]

The lock receiver 15 is integrated with the outside linkage segment 7 according to the above embodiments. Alternatively, the lock receiver 15 may be integrated with the inside linkage segment 6, which feature is not shown.

The lock receiver 15 integrated with the inside linkage segment 6 protrudes rearward from the rear surface of the

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inside linkage segment 6, for example. This modification requires changes in the curvatures of the arc profiles of the upper surface 71 and the bottom surface 72 of the lock receiver 15 and thus a change in the arrangement of the teeth 70. For example, the teeth 70 are disposed on the upper surface 71 having a smaller curvature.

The lock receiver 15 integrated with the inside linkage segment 6 can also rotate in conjunction with the inside linkage segment 6, like the lock receiver 15 integrated with the outside linkage segment 7. In other words, the X linkage and the front-rear locking mechanism can move together. The movable unit 5 can thus be readily shifted in the front-rear direction.

This modification can satisfy the requirement for the ready adjustment of the position of the movable unit 5 in the front-rear direction through the association of the movement of the X linkage and the front-rear locking mechanism.

[Modification 2]

The lock receiver 15 is disposed in the center between the first and second headrest pillars 2a and 2b according to the above embodiments. Alternatively, the lock receiver 15 may be disposed in a right or left portion relative to the center between the first and second headrest pillars 2a and 2b, which feature is not shown.

The lock receiver 15 deviated to one side protrudes rearward from the rear surface of the first arm 40 or the second arm 41 of the inside linkage segment 6, for example.

The position of the lock receiver 15, which is disposed in the right or left portion relative to the center between the first and second headrest pillars 2a and 2b, is deviated from the center to one side. The X linkage thus can have an increased width corresponding to the deviated length of the lock receiver 15.

This modification can satisfy the requirement for an increase in width of the X linkage corresponding to the deviated length of the lock receiver 15.

[Modification 3]

The lock receiver 15 is disposed in the center between the first and second headrest pillars 2a and 2b according to the above embodiments. Alternatively, multiple lock receivers may be disposed in right and left portions relative to the center between the first and second headrest pillars 2a and 2b, as illustrated in FIGS. 12 and 13. The multiple lock receivers disposed in the right and left portions are herein-after referred to as "lock receivers 15A."

If such multiple lock receivers are provided, the inside linkage segment 6 does not need to receive the lock receiver 15 at the center and thus does not necessarily include the first arm 40 and the second arm 41. According to the modification, the inside linkage segment 6 is replaced with a wide single-arm inside linkage segment 6A having a width substantially equal to the sum of the widths of the first arm 40 and the second arm 41 and the width of the space between the arms 40 and 41.

The outside linkage segment 7 also does not need to be provided with the lock receiver 15 at the center. The outside linkage segment 7 is thus replaced with a wide single-arm outside linkage segment 7A having a width substantially equal to the sum of the widths of the first arm 50 and the second arm 51.

The lock receivers 15A each have a thickness in the right-left direction substantially half the thickness of the lock receiver 15.

The lock receivers 15A are respectively disposed in right and left spaces S defined by the stationary unit 4 and the X linkage in the right-left direction. The spaces S each have a width in the right-left direction substantially equal to the

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thickness of right and left side walls **53A** provided to the right and left lateral edges, respectively, of the outside linkage segment **7A**.

The lock receivers **15A** are integrated with the respective rear ends of the right and left side walls **53A** of the outside linkage segment **7A**.

The lock receivers **15A** each have the same shape as that of the lock receiver **15** as viewed from the side. In other words, the lock receivers **15A** each include multiple teeth **70A**.

A stationary unit **4A** according to the modification has multiple clearances **17A** corresponding to the respective lock receivers **15A**. Each of the clearances **17A** is a through hole extending through the stationary unit **4**, like the clearance **17**.

The stationary unit **4A** is further provided with multiple locking components **16A** above the respective clearances **17A** such that the locking components **16A** can swing in the right-left direction. In other words, the locking components **16A** correspond to the respective lock receivers **15A**.

A operation unit **9A** according to the modification includes a first shaft segment **60A** to operate one of the locking components **16A** provided in the left portion. The first shaft segment **60A** is shorter than the first shaft segment **60**.

The operation unit **9A** further includes an extension shaft segment **60Aa** to operate the other locking component **16A** provided in the right portion. The extension shaft segment **60Aa** bends in the vicinity of the tip of the first shaft segment **60A** to avoid the left locking component **16A**. The tip of the extension shaft segment **60Aa** abuts on the right locking component **16A**.

The operation unit **9A** can thus simultaneously operate the locking components **16A** and thus can simultaneously disengage the locking components **16A** from the lock receivers **15A**. In other words, the operation unit **9A** can efficiently unlock the multiple separate locking mechanisms in the right and left portions relative to the center between the first and second headrest pillars **2a** and **2b** through a single operation.

The front-rear locking mechanism according to the modification, which includes the lock receivers **15A** disposed in the right and left portions relative to the center between the first and second headrest pillars **2a** and **2b**, can achieve a balanced locking or unlocking operation over multiple positions in the width direction of the headrest **1**. This modification can satisfy the requirement for a balanced locking or unlocking operation of the front-rear locking mechanism over multiple positions in the width direction of the headrest **1**.

Furthermore, the X linkage disposed between the lock receivers **15A** can be centered and rotate smoothly.

In addition, the lock receivers **15A** are disposed in the spaces **S** defined by the stationary unit **4A** and the X linkage and thus such configuration can contribute the production of a compact headrest **1** without being blocked by the lock receivers **15A**.

[Modification 4]

The operation unit **9A** includes the extension shaft segment **60Aa** according to Modification 3. Alternatively, the locking components **16A** may be coupled to each other with a coupler **16Aa** such that the locking components **16A** move in synchronization, as illustrated in FIG. **14**.

The coupler **16Aa** can function as a link rotatably coupling the locking components **16A**.

The locking components **16A** are coupled to each other with the coupler **16Aa**; hence, an operation of the first shaft segment **60A** of the operation unit **9A** on one of the locking

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components **16A** can simultaneously disengage all the locking components **16A** from the lock receivers **15A**. In other words, the operation unit **9A** can efficiently unlock the multiple separate locking mechanisms in the right and left portions relative to the center between the first and second headrest pillars **2a** and **2b** through a single operation.

This modification can satisfy the requirement for a single efficient unlocking operation of the multiple separate locking mechanisms in the right and left portions relative to the center between the first and second headrest pillars **2a** and **2b**.

[Modification 5]

The headrest **1** is mounted to the seat back frame **10a** via the holders **80** for holding lower portions of the first and second headrest pillars **2a** and **2b** according to the above embodiments. Alternatively, the lower portions of the first and second headrest pillars **2a** and **2b** may be directly fixed to the upper end of the seat back frame **10a**, as illustrated in FIG. **15**. According to the modification, the lower portions of the first and second headrest pillars **2a** and **2b** are welded to the upper end of the seat back frame **10a**.

The top end of the seat back **10** receives the first and second headrest pillars **2a** and **2b** and is equipped with decorative sleeve caps **85** for decorating the respective boundaries between the seat back **10** and the first and second headrest pillars **2a** and **2b**. In other words, the flanges of the caps **85** are exposed from the top end of the seat back **10**.

The direct fixation of the lower portions of the first and second headrest pillars **2a** and **2b** to the upper end of the seat back frame **10a** can securely mount the headrest **1** to the seat back **10**.

This modification can satisfy the requirement for the secure mounting of the headrest **1** to the seat back **10**.

In this embodiment, the X linkage including the inside linkage segment **6** and the outside linkage segment **7** is rotatably connected to and supported by the supports **21**, **22**, **31**, and **32**. The supports **21**, **22**, **31**, and **32** each have a width and a thickness in the front-rear (thickness) direction, the width being greater than the thickness. This configuration provides high rigidity in the supports **21**, **22**, **31**, and **32**. The supports **21**, **22**, **31**, and **32** are barely affected by the impact of internal stress applied in various directions. As a result, the supports **21**, **22**, **31**, and **32** can stably support the inside linkage segment **6** and the outside linkage segment **7**.

The portions of the inside linkage segment **6** and the outside linkage segment **7**, which are supported by the supports **21** and **22** of the stationary unit **4**, overlap with the supports **21** and **22** in right-left direction. The portions of the inside linkage segment **6** and the outside linkage segment **7**, which are supported by the supports **31** and **32** of the movable unit **5**, overlap with the supports **31** and **32** in the right-left direction. Thus, the inside linkage segment **6** and the outside linkage segment **7** can collapse such that the stationary unit **4** and the movable unit **5** are in immediate proximity to each other when the movable unit **5** is brought back. As a result, the headrest **1** can get more compact.

This embodiment thereby suitably meets demands for further compactness of the headrest **1**.

The lower supports **22** and **22** of the stationary unit **4** and the lower supports **32** and **32** of the movable unit **5** are longer than the respective upper supports **21** and **31** in the vertical direction. Thus, the lower supports **22** and **32** have greater rigidity than the upper supports **21** and **31**. The lower end of the inside linkage segment **6** and the lower end of the outside linkage segment **7** can move along the respective lower supports **32** and **22** in the vertical direction. Thus, the movable unit **5** can move forward away from the stationary

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unit 4 and backward toward the stationary unit 4 with the heights of the upper ends of the inside linkage segment 6 and the outside linkage segment 7 kept unchanged such that the lower ends of the inside linkage segment 6 and the outside linkage segment 7 move along the respective lower supports 32 and 22. The movable unit 5 can thereby move forward away from the stationary unit 4 and backward toward the stationary unit 4 without any change in height with respect to the stationary unit 4.

In other words, this configuration enables the movable unit 5 to move without any change in height with respect to the stationary unit 4 through the lower supports 22 and 32 and provides high rigidity in the lower supports 22 and 32.

The upper fixing portions 23 and 23 among the plurality of fixing portions 23 are disposed at a height substantially equal to the height of the upper supports 21 and 21 of the stationary unit 4 and thus in proximity thereto. Thus, the upper fixing portions 23 and 23 reinforce the upper supports 21 and 21 and vice versa. This configuration provides high rigidity both in portions at which the body 4b is fixed to the base 4a and in portions at which the upper supports 21 and 21 are connected to the inside linkage segment 6 or the outside linkage segment 7.

The upper fixing portions 23 and 23 among the plurality of fixing portions 23 are disposed at a height different from the height of the upper supports 21 and 21 of the stationary unit 4. Thus, connection of the upper supports 21 and 21 to the inside linkage segment 6 or the outside linkage segment 7 and fixing of the upper fixing portions 23 and 23 to the base 4a can be performed at different heights. This configuration facilitates the assembly of each member of the stationary unit 4.

This configuration thereby suitably satisfies demands for easier assembly of each member of the headrest 1.

The reinforcing ribs 24 and 24 are disposed between and are integrated with the upper supports 21 and 21 and the lower supports 22 and 22 in the stationary unit 4. Thus, the stationary unit 4 achieves high rigidity. The upper fixing portions 23 and 23 among the plurality of fixing portions 23 are disposed at a height substantially equal to the height of the reinforcing ribs 24 and 24. This configuration provides high rigidity in portions at which the body 4b is fixed to the base 4a even if the upper fixing portions 23 and 23 are disposed at a height different from the height of the upper supports 21 and 21.

The lower fixing portions 23 and 23 among the plurality of fixing portions 23 are disposed at a height substantially equal to the height of the lower supports 22 and 22 of the stationary unit 4. Thus, the lower fixing portions 23 and 23 reinforce the lower supports 22 and 22 and vice versa. This configuration provides high rigidity both in portions at which the body 4b is fixed to the base 4a and in portions at which the lower supports 22 and 22 are connected to the inside linkage segment 6 or the outside linkage segment 7.

The supports 21 and 22 of the stationary unit 4 are disposed behind the virtual line V1 joining the axes of the first and the second headrest pillars 2a and 2b. Thus, the stationary unit 4 is accommodated in a space between the first and the second headrest pillars 2a and 2b. The inside linkage segment 6 and the outside linkage segment 7 of the X linkage can also be accommodated as much as possible in the space between the first and the second headrest pillars 2a and 2b when the movable unit 5 is brought back. As a result, the headrest 1 can get more compact.

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This configuration thereby suitably satisfies demands for further compactness of the headrest 1.

## INDUSTRIAL APPLICABILITY

The claimed headrest can be applied to a seat installed in a vehicle.

## REFERENCE SIGNS LIST

- 1 headrest
- 2a first headrest pillar
- 2b second headrest pillar
- 3a pillar retainer
- 3b pillar retainer
- 4 stationary unit
- 5 movable unit
- 6 inside linkage segment
- 7 outside linkage segment
- 8 connecting intersection
- 9 operation unit
- 10 seat back
- 10a seat back frame
- 14 locking unit
- 15 lock receiver
- 16 locking component
- 17 clearance
- 21 support
- 22 support
- 22a elongated opening
- 30 recessed portion
- 31 support
- 32 support
- 32a elongated opening
- 33 headrest casing
- 40 first arm
- 41 second arm
- 42 connection
- 50 first arm
- 51 second arm
- 52 connection
- 60 first shaft segment
- 61 second shaft segment
- 62 connecting shaft segment
- 70 tooth

The invention claimed is:

1. A headrest comprising:

a first headrest pillar and a second headrest pillar;  
a stationary unit disposed between the first and the second headrest pillars;

a movable unit movable forward away from the stationary unit and backward toward the stationary unit; and

a linkage linking the stationary unit with the movable unit, wherein the stationary unit includes a plate-like base fixed to the first and the second headrest pillars and a body attached to a front face of the base, the body being connected to the linkage,

the body includes a plate, a plurality of supports rotatably connecting to and supporting respective linkage segments constituting the linkage and a plurality of fixing portions,

the plate is fixed to the base with the fixing portions,

the supports are integrated with the plate at four corners of the plate so as to protrude forward from the front surface of the plate, and

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the supports each have a first size in a widthwise direction of the headrest and a second size in an front-rear direction of the headrest, the first size being greater than the second size.

2. The headrest according to claim 1, wherein the supports of the stationary unit are disposed on both lateral sides of the stationary unit and the supports of the movable unit are disposed on both lateral sides of the movable unit, and

the linkage segments of the linkage are disposed between the supports on both lateral sides of the stationary unit and between the supports on both lateral sides of the movable unit.

3. The headrest according to claim 1, wherein the linkage is an X linkage comprising an inside linkage segment and an outside linkage segment rotatably connected to each other via a connecting intersection located in the center of the X linkage, wherein

the supports of the stationary unit are disposed on both upper and lower sides of the stationary unit and the supports of the movable unit are disposed on both upper and lower sides of the movable unit,

the lower support among the supports on the stationary unit and the lower support among the supports on the movable unit are longer than the respective upper supports in length in a vertical direction of the headrest, and

a lower end of the inside linkage segment and a lower end of the outside linkage segment are movable along the respective lower supports in the vertical direction.

4. The headrest according to claim 3, wherein the body includes a plurality of fixing portions integrated with the body on at least four corners of the body and fixed to the base, and

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upper fixing portions among the fixing portions are disposed at a height substantially equal to a height of the upper support on the stationary unit.

5. The headrest according to claim 3, wherein the body includes a plurality of fixing portions integrated with the body on at least four corners of the body and fixed to the base, and

upper fixing portions among the fixing portions are disposed at a height different from a height of the upper support on the stationary unit.

6. The headrest according to claim 5, wherein the stationary unit further includes an integrated reinforcing rib between the upper and the lower supports, and the upper fixing portions among the fixing portions are disposed at a height substantially equal to a height of the reinforcing rib.

7. The headrest according to claim 4, wherein lower fixing portions among the fixing portions are disposed at a height substantially equal to a height of the lower support on the stationary unit.

8. The headrest according to claim 1, wherein the supports on the stationary unit are disposed behind a virtual line joining axes of the first and the second headrest pillars.

9. The headrest according to claim 1, wherein the base is composed of a metal and the body is composed of a resin.

10. The headrest according to claim 1, wherein the supports of the stationary unit are disposed on both upper and lower sides of the stationary unit and the fixing portion is disposed between the supports disposed on the upper and lower sides.

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